

## HRS DOCUMENTATION RECORD--REVIEW COVER SHEET

Name of Site: Safety Light Corporation

EPA ID No.: PAD987295276

### Contact Persons

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### Pathways, Components, or Threats Not Evaluated

The soil exposure and air migration pathways were not evaluated. Although surface soil contamination has been identified throughout the facility property, a significant number of soil exposure targets have not been identified for this property. Detailed air sampling data is not available. Therefore, the soil exposure and air migration pathways would contribute minimally to the overall score.

## HRS DOCUMENTATION RECORD

Name of Site: Safety Light Corporation  
EPA ID No. PAD987295276

EPA Region: Region 3 Date Prepared: January 22, 2003

Street Address of Site\*: 4150-A Old Berwick Road

County and State: Columbia County, Pennsylvania

General Location in the State: East Central, Pennsylvania

Topographic Map: Bloomsburg, Pennsylvania, 1999

Latitude: 41° 00' 55" North Longitude: 76° 22' 35" West

The latitude and longitude coordinates were calculated from the main plant building (Ref. 3).

### Scores

Ground Water Migration Pathway	100.00
Surface Water Migration Pathway	100.00
Soil Exposure Pathway	Not Scored
Air Migration Pathway	Not Scored

<b>HRS SITE SCORE</b>	<b>70.71</b>
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\*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

# WORKSHEET FOR COMPUTING HRS SITE SCORE

		<u>S</u>	<u>S<sup>2</sup></u>
1.	Ground Water Migration Pathway Score (S <sub>gw</sub> ) (from Table 3-1, line 13)	<u>100</u>	<u>10,000</u>
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	<u>100</u>	<u>10,000</u>
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	<u>NS</u>	<u>NS</u>
2c.	Surface Water Migration Pathway Score (S <sub>sw</sub> ) (Enter the larger of lines 2a and 2b as the pathway score.)	<u>100</u>	<u>10,000</u>
3.	Soil Exposure Pathway Score (S <sub>s</sub> ) (from Table 5-1, line 22)	<u>NS</u>	<u>NS</u>
4.	Air Migration Pathway Score (S <sub>a</sub> ) (from Table 6-1, line 12)	<u>NS</u>	<u>NS</u>
5.	Total of S <sub>gw</sub> <sup>2</sup> + S <sub>sw</sub> <sup>2</sup> + S <sub>s</sub> <sup>2</sup> + S <sub>a</sub> <sup>2</sup>		<u>20,000</u>
6.	<b>HRS Site Score</b> (Divide the value on line 5 by 4 and take the square root)		<u>70.71</u>

S = Pathway Score

S<sup>2</sup> = Square of Pathway Score

NS = Not Scored

Site Name: Safety Light Corporation  
 Location: Bloomsburg, Columbia County, Pennsylvania

## GROUND WATER MIGRATION PATHWAY SCORESHEET - **Hamilton Group Aquifer**

### Factor Categories and Factors

	<u>Likelihood of Release to an Aquifer</u>	<u>Maximum Value</u>	<u>Value Assigned</u>
1.	Observed Release	550	<u>550</u>
2.	Potential to Release		
2a.	Containment	10	<u>-</u>
2b.	Net Precipitation	10	<u>-</u>
2c.	Depth to Aquifer	5	<u>-</u>
2d.	Travel Time	35	<u>-</u>
2e.	Potential to Release (lines 2a x [2b + 2c + 2d])	500	<u>-</u>
3.	Likelihood of Release (higher of lines 1 and 2e)	550	<u>550</u>

### Waste Characteristics

4.	Toxicity/Mobility	<sup>a</sup>	<u>10,000</u>
5.	Hazardous Waste Quantity	<sup>a</sup>	<u>10,000</u>
6.	Waste Characteristics	100	<u>100</u>

### Targets

7.	Nearest Well	50	<u>50</u>
8.	Population		
8a.	Level I Concentrations	<sup>b</sup>	<u>96.8</u>
8b.	Level II Concentrations	<sup>b</sup>	<u>0</u>
8c.	Potential Contamination	<sup>b</sup>	<u>54.8</u>
8d.	Population (lines 8a + 8b + 8c)	<sup>b</sup>	<u>151.6</u>
9.	Resources	5	<u>0</u>
10.	Wellhead Protection Area	20	<u>0</u>
11.	Targets (lines 7 + 8d + 9 + 10)	<sup>b</sup>	<u>201.6</u>

### Ground Water Migration Score for an Aquifer

12.	Aquifer Score ([lines 3 x 6 x 11]/82,500) <sup>c</sup>	100	<u>100</u>
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### Ground Water Migration Pathway Score

13.	Ground Water Migration Pathway Score (S <sub>gw</sub> ) <sup>c</sup> (highest value from line 12 for all aquifers evaluated)	100	<u>100</u>
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<sup>a</sup> Maximum value applies to waste characteristics category.

<sup>b</sup> Maximum value not applicable.

<sup>c</sup> Not rounded to the nearest integer.

- Not evaluated.

Site Name: Safety Light Corporation  
 Location: Bloomsburg, Columbia County, Pennsylvania

**SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET**

<u>Factor Categories and Factors</u>	<u>Maximum Value</u>	<u>Value Assigned</u>	
<b>DRINKING WATER THREAT</b>			
<u>Likelihood of Release</u>			
1. Observed Release	550	<u>550</u>	
2. Potential to Release by Overland Flow			
2a. Containment	10	<u>-</u>	
2b. Runoff	25	<u>-</u>	
2c. Distance to Surface Water	25	<u>-</u>	
2d. Potential to Release by Overland Flow (lines 2a x [2b + 2c])	500	<u>-</u>	
3. Potential to Release by Flood			
3a. Containment (Flood)	10	<u>-</u>	
3b. Flood Frequency	50	<u>-</u>	
3c. Potential to Release by Flood (lines 3a x 3b)	500	<u>-</u>	
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	<u>-</u>	
5. Likelihood of Release (higher of lines 1 and 4)	550		<u>550</u>
<u>Waste Characteristics</u>			
6. Toxicity/Persistence	a	<u>10,000</u>	
7. Hazardous Waste Quantity	a	<u>10,000</u>	
8. Waste Characteristics	100		<u>100</u>
<u>Targets</u>			
9. Nearest Intake	50	<u>0</u>	
10. Population			
10a. Level I Concentrations	b	<u>0</u>	
10b. Level II Concentrations	b	<u>0</u>	
10c. Potential Contamination	b	<u>0</u>	
10d. Population (lines 10a + 10b + 10c)	b	<u>0</u>	
11. Resources	5	<u>5</u>	
12. Targets (lines 9 + 10d + 11)	b		<u>5</u>

Site Name: Safety Light Corporation  
 Location: Bloomsburg, Columbia County, Pennsylvania

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET, Continued

<u>Factor Categories and Factors</u>	<u>Maximum Value</u>	<u>Value Assigned</u>
<b>DRINKING WATER THREAT (Concluded)</b>		
<u>Drinking Water Threat Score</u>		
13. Drinking Water Threat Score ([lines 5 x 8 x 12]/82,500, subject to a maximum of 100)	100	<u>3.33</u>
<b>HUMAN FOOD CHAIN THREAT</b>		
<u>Likelihood of Release</u>		
14. Likelihood of Release (value from line 5)	550	<u>550</u>
<u>Waste Characteristics</u>		
15. Toxicity/Persistence/Bioaccumulation	<sup>a</sup>	<u>5 x 10<sup>8</sup></u>
16. Hazardous Waste Quantity	<sup>a</sup>	<u>10,000</u>
17. Waste Characteristics	1,000	<u>1,000</u>
<u>Targets</u>		
18. Food Chain Individual	50	<u>20</u>
19. Population		
19a. Level I Concentrations	<sup>b</sup>	<u>0</u>
19b. Level II Concentrations	<sup>b</sup>	<u>0</u>
19c. Potential Human Food Chain Contamination	<sup>b</sup>	<u>0.0000003</u>
19d. Population (lines 19a + 19b + 19c)	<sup>b</sup>	<u>0.0000003</u>
20. Targets (lines 18 + 19d)	<sup>b</sup>	<u>20.0000003</u>
<u>Human Food Chain Threat Score</u>		
21. Human Food Chain Threat Score ([lines 14 x 17 x 20]/82,500, subject to a maximum of 100)	100	<u>100</u>
<b>ENVIRONMENTAL THREAT</b>		
<u>Likelihood of Release</u>		
22. Likelihood of Release (value from line 5)	550	<u>550</u>

Site Name: Safety Light Corporation  
 Location: Bloomsburg, Columbia County, Pennsylvania

**SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET, Concluded**

<u>Factor Categories and Factors</u>	<u>Maximum Value</u>	<u>Value Assigned</u>
<b>ENVIRONMENTAL THREAT (Concluded)</b>		
<u>Waste Characteristics</u>		
23. Ecosystem Toxicity/Persistence/ Bioaccumulation	<sup>a</sup>	<u>5 x10<sup>8</sup></u>
24. Hazardous Waste Quantity	<sup>a</sup>	<u>10,000</u>
25. Waste Characteristics	1,000	<u>1,000</u>
<u>Targets</u>		
26. Sensitive Environments		
26a. Level I Concentrations	<sup>b</sup>	<u>0</u>
26b. Level II Concentrations	<sup>b</sup>	<u>0</u>
26c. Potential Contamination	<sup>b</sup>	<u>0.005</u>
26d. Sensitive Environments (lines 26a + 26b + 26c)	<sup>b</sup>	<u>0.005</u>
27. Targets (value from line 26d)	<sup>b</sup>	<u>0.005</u>
<u>Environmental Threat Score</u>		
28. Environmental Threat Score ([lines 22 x 25 x 27]/82,500, subject to a maximum of 60)	60	<u>0.03</u>
<b>SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE FOR A WATERSHED</b>		
29. Watershed Score <sup>c</sup> (lines 13 + 21 + 28, subject to a maximum of 100)	100	<u>100</u>
<b>SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE</b>		
30. Component Score (S <sub>of</sub> ) <sup>c</sup> (highest score from line 29 for all watersheds evaluated, subject to a maximum of 100)	100	<u>100</u>

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<sup>a</sup> Maximum value applies to waste characteristics category.  
<sup>b</sup> Maximum value not applicable.  
<sup>c</sup> Not rounded to the nearest integer.  
 - Not evaluated.

A copy of *Figure 1* is available at the EPA Headquarters Superfund Docket:

Public Reading Room, Room B102  
EPA West Building  
1301 Constitution Avenue, NW  
Washington, DC 20004

Telephone: (202) 566-1744

E-Mail: [superfund.docket@epa.gov](mailto:superfund.docket@epa.gov)

A copy of *Figure 2* is available at the EPA Headquarters Superfund Docket:

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EPA West Building  
1301 Constitution Avenue, NW  
Washington, DC 20004

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A copy of *Figure 3* is available at the EPA Headquarters Superfund Docket:

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A copy of *Figure 4* is available at the EPA Headquarters Superfund Docket:

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Washington, DC 20004

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E-Mail: [superfund.docket@epa.gov](mailto:superfund.docket@epa.gov)

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### General Site Description

The Safety Light Corporation (SLC) facility, EPA ID No. PAD987295276, is located at 4150-A Old Berwick Road in South Centre Township near Bloomsburg, Columbia County, Pennsylvania (Refs. 4, p. 3.1; 5). More specifically, the geographic coordinates of the SLC facility are latitude 41° 00' 55" north and longitude 76° 22' 35" west (Ref. 3). The SLC facility is situated on a 2 acres of land that is part of a 10-acre parcel formerly owned by U.S. Radium Corporation (USRC) (Refs. 4, p. 3.1; 6, p. 3). The SLC facility is bounded on the north by Old Berwick Road, on the east and west by residential areas, and on the south by the North Branch of the Susquehanna River (Refs. 3; 56). Land use in the immediate vicinity of the SLC facility is primarily residential, industrial, and commercial (Ref. 3).

The SLC facility is totally enclosed by a security fence. Several buildings are located on the property, including three buildings used for manufacturing products, one building used for storing radioactive waste, and buildings used for offices and nonradiological activities (Refs. 6, p. 1; 9, pp. 1-1, 2-1; 23, p. 4). Other features of the property include areas reportedly used for the burial of low-level radioactive waste. These areas include an abandoned canal that runs the length of the property east to west, along the Susquehanna River; two lagoons (the east and west lagoons as surface impoundments), disposal/burial pits, underground and aboveground silos, and liquid waste tanks (Ref. 9, pp. 2-1, 2-4). The abandoned canal traversed the north bank of the Susquehanna River from Sunbury to Scranton, passing through the SLC property (Ref. 6, p. 78). The lagoons are partially located in the bed of the abandoned canal (Refs. 6, p. 78; 18, p. 32; 23, p. 4). Most of the buildings are located in the northern half of the property and the other features/structures are located in the southern half of the property, along the North Branch of the Susquehanna River (Ref. 23, p. 4).

The SLC facility was first used to manufacture wooden toys during World War II (Refs. 7, p. 1; 8, p. 1). In the late 1940s, USRC purchased the facility and began manufacturing self-illuminated watch and instrument dials, smoke detectors, neutron sources, and other merchandise containing radioactive materials (Refs. 7, p. 1; 8, p. 1; 9, p. 2-5). From the 1940s to the 1960s, manufacturing at the facility used the following radionuclides: promethium-14, strontium-90, thallium-202, hydrogen-3 (tritium), radium-226, carbon-14, cesium-137, cobalt-60, krypton-85, and nickel-63, among others (Refs. 7, p. 1; 8, p. 1; 9, pp. 1-1, 2-5, 5-1; 10, p. 2; 12, p. 1; 13, p. 2). However, radium was the most widely used radionuclide at the SLC facility (Ref. 8, p. 1). Prior to 1980, USRC created a new corporation, USR Industries. USRC later became a wholly owned subsidiary of USR Industries. On November 24, 1980, activities regulated under the U.S. Nuclear Regulatory Commission (NRC) became known as Safety Light Corporation. SLC currently operates under NRC licence Nos. 37-00030-02 and 37-00030-08, and Pennsylvania Department of Environmental Protection (PADEP) License No. PA-0166 (Refs. 6, p. 2; 22; 48; 56). Several subsidiaries of USR Industries subsequently were formed and conducted nonradiological operations. Multi-Metals, Inc., (Multi-Metals) one of the USR Industries subsidiaries that is collocated with SLC, conducts metal plating operations at the facility and manufactures the watch dials and enclosures for SLC (Refs. 11; 56, pp. 11, 12, 13).

Prior to 1980, activities involving radium-226 and most other radionuclides ceased, and tritium remained as the only radionuclide used in the manufacturing of self-illuminating watch dials, instruments, and other products (Refs. 9, p. 2-6). Wastes generated at the SLC facility include solid and liquid wastestreams contaminated with radioactive materials, including radium-226, strontium-90, cesium-137, and tritium (Refs. 9, p. 4-1; 10, p. 2). Contaminated laboratory glassware was buried on the property (Ref. 14, p. 3). Contaminated solids were placed inside two old silos buried in the ground, which were 12 feet deep by 10 feet wide (Refs. 6, p. 78; 12, p. 2). Concentrated liquid wastes were allowed to evaporate, and the dry residuals were transferred to the Radiological Services Company (Ref. 7, p. 3). Additionally, plant effluent was discharged into the abandoned canal, located adjacent to the Susquehanna River (Ref. 15, p.

7). These canals were a series of about five individual impoundments that were all part of the former river bed (Ref. 15, pp. 1, 2, 4, 7). The canals were filled with river water, allowing the wastes in them to be diluted prior to discharge into the Susquehanna River (Ref. 15, pp. 2, 5).

Several sampling investigations and environmental assessments have been conducted at the SLC facility. In 1979, SLC conducted a hydrogeologic investigation of alluvial ground water system at the former USRC facility (Ref. 18). The purpose of this investigation was to install permanent monitoring wells to determine the depth to ground water, water table gradients, flow directions, existing water quality with the extent of radiological contamination and to propose pollution abatement techniques (Ref. 18, p. 1). During this investigation, two test pits were dug with a backhoe in the vicinity of the former canal (Ref. 18, pp. 32, 33). While these pits were being dug, water was encountered at a depth of about 5 feet below ground surface (bgs) (Ref. 18, p. 33). Old fill material from the backfilled canal was encountered within the ground water, including wood and radioactive debris. An oily odor was noted during excavation of an on-site test pit (Ref. 18, pp. 32, 33). Ground water flow direction on the SLC property was noted to be heading toward the Susquehanna River (Ref. 18, p. 37).

In 1981, the NRC, conducted an environmental survey of the SLC facility (Ref. 10, p. 1). The purpose of the environmental survey was to determine the accuracy of routine measurements performed by the SLC facility and to evaluate the adequacy of the SLC facility's environmental control and monitoring program (Ref. 10, p. 1). During the environmental assessment, the NRC measured direct radiation levels in unrestricted areas around the SLC facility, monitored releases of tritium in air stack and liquid effluent from SLC activities, and measured levels of radiation in the environment which resulted from past and present operations at the SLC facility (Ref. 10, p. 4). Baseline soil and water samples were collected for comparison to soil and water samples collected onsite and in the vicinity of the SLC facility (Ref. 10, p. 10). Surface water samples collected from the east lagoon and an on-site drainage ditch contained radium-226 at concentrations two times the baseline water samples. The concentration of tritium in the east lagoon was about three times the maximum level detected in the baseline water samples. Most ground water samples collected from on-site monitoring wells contained tritium above the baseline water samples. Monitoring Well 21 contained the highest concentration of tritium at  $7.22 \times 10^{-5}$  microcuries per milliliter ( $\mu\text{Ci/ml}$ ) (Ref. 10, p. 13). Monitoring Well 5 contained the highest concentration of radium-226 at  $9.1 \times 10^{-9}$   $\mu\text{Ci/ml}$ , and Monitoring Well 13 contained the highest concentration of cesium-137 at  $5.7 \times 10^{-8}$   $\mu\text{Ci/ml}$  (Ref. 10, p. 14). Monitoring Wells 1, 3, and 4 contained strontium-90 at concentrations of  $6.21 \times 10^{-5}$ ,  $2.13 \times 10^{-6}$ , and  $4.77 \times 10^{-7}$   $\mu\text{Ci/ml}$ , respectively; these concentrations were higher than the NRC guideline level of  $3 \times 10^{-7}$   $\mu\text{Ci/ml}$  of strontium-90 in unrestricted areas (Ref. 10, p. 14). Surface and subsurface soil samples collected from the southwestern portion of the SLC facility contained the highest concentrations of radionuclides. The highest concentrations of radionuclides in surface soil samples were as follows: radium-226 in sample 45B at 672 picocuries per gram ( $\text{pCi/g}$ ); cesium-137 at 631  $\text{pCi/g}$  and strontium-90 at 15.4  $\text{pCi/g}$  in sample 46B (Ref. 10, pp. 14, 43, 44). The highest concentrations of radionuclides in the subsurface soil samples were: radium-226 at 19.8  $\text{pCi/g}$  in sample 16 collected at 1 meter (m) bgs; cesium-137 at 286  $\text{pCi/g}$  in sample 10 collected at 0.3 m bgs; strontium-90 at 13.3  $\text{pCi/g}$  in sample 22 collected 1 m bgs; and tritium at 3.1  $\text{pCi/g}$  in sample 9 collected at 2.7 m bgs (Ref. 10, pp. 14, 45, 46, 47). The survey concluded that the soil and water contamination are present in areas previously used for waste disposal activities and are evidence of radionuclide migration from the SLC facility (Ref. 10, p. 16).

In June and July 1990, SLC conducted a soil coring/monitoring well program and hydrogeological/radiological evaluation of the facility (Ref. 13, p. 1). The purpose of the evaluation was to determine the nature, scope, location, and movement of radioactive contamination at the SLC facility and to gather characterization data. This work was done in response to a Partial Interim Settlement between USR Industries (now SLC) and the NRC, and in response to a March 1990 NRC Order (Ref. 13, p. 1). As part

of the evaluation, SLC installed and sampled 9 new monitoring wells, sampled existing on-site monitoring wells, conducted a magnetic survey to identify buried objects, conducted soil coring for radiological analyses, and collected rainwater samples (Ref. 13, p. 4). Analyses of the ground water samples showed an increase in tritium concentrations throughout the SLC facility, particularly in the southeastern portion of the facility (Ref. 13, pp. 17, 18, 24, Table 3). Numerous buried magnetic objects were detected on the Vance-Walton property located adjacent to the SLC facility on the east, and near the southeastern fence line of the SLC property. Also, a concentration of metal objects were observed within the suspected boundaries of the abandoned canal (Ref. 13, p. 18). High concentrations of tritium and strontium-90 were detected in surface and subsurface soil samples, particularly at the surface and in the saturated zone (Ref. 13, pp. 21, 22, 23, Tables 5 and 6). Rainwater samples were collected from locations along the eastern and southern borders of the SLC facility. Samples along the southern border along the bank of the Susquehanna River contained tritium from non-detect at the southeast corner to 24,600 picocuries per liter (pCi/L) at a location just south of the underground silos. Samples collected in the vicinity of drill sites B, C, D, and E contained tritium from 51,700 pCi/L to 130,000 pCi/L (Ref. 13, pp. 23, 24, Figure 14, Table 7).

In 1993 and 1994, the EPA Region 3 Technical Assistance Team (TAT) conducted soil and ground water sampling at the SLC facility and vicinity (Refs. 28; 41). Analyses of soil samples indicated the presence of elevated concentrations of inorganic constituents including antimony, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, and zinc (Ref. 28, pp. 8, 9, 10, 17 through 30). Analyses of the ground water samples indicated the presence of tritium at elevated concentrations in on-site monitoring wells and nearby residential wells (Ref. 41, pp. 10 through 13).

From May to December 1995, SLC conducted a site characterization of the facility (Ref. 4, p. iii-1). The primary objective of the characterization plan was to provide sufficient information for the subsequent preparation of a site decommissioning and remediation plan, and later release of all or part of the SLC facility for unrestricted use (Ref. 4, p. iii-1). The objectives of the site characterization were conducted in five tasks including the determination of the extent of radiological contamination on the SLC grounds, whether radioactive materials are buried on site, and the extent of radiological contamination inside the on-site buildings; access the underground silos and obtain information on their contents; and install boreholes and wells and collect ground water and subsurface soil samples (Ref. 4, p. iii-1). Analyses of soil samples collected throughout the SLC facility property indicated the presence of radionuclides including radium-226, cesium-137, and americium-241; extractable hydrocarbons; and heavy metals including cadmium, chromium, copper, nickel, lead, and zinc, among others (Ref. 4, pp. 8.17, 8.18, Appendix 10 and 11). The ground penetrating radar survey indicated the presence of small metallic objects (possibly radium dials) buried in the west dump. The electronic survey results were consistent with surface metallic objects rather than buried objects (Ref. 4, p. 9.7). The examination of the underground silos indicated that the east silo contained material to within 1 foot of the concrete lid (Ref. 4, p. 10.2). Both silos contained glass jars, bottles, and watch dials. Re-crystallization was observed in both silos indicating that their insides were once moist (Ref. 4, pp. 10.2, 10.3, 10.4). Thirteen boreholes/wells were installed during the characterization activities (Ref. 4, p. 11.1). Of the soil samples collected from the boreholes, the highest concentration of cesium-137 (99 pCi/g) was detected in sample M12 collected at 1.2 feet bgs (Ref. 4, p. 11.5). The highest concentration of radium-226 (215 pCi/g) was detected in borehole M5 located south of the east lagoon (Ref. 4, pp. 11.5, 11.6). Radionuclides including radium-226, cesium-137, and tritium were detected in on-site monitoring well samples (Ref. 4, p. 11.8, Appendix 17). Volatile organic compounds were detected in onsite ground water samples and heavy metals were detected in on-site soil and ground water samples (Ref. 4, pp. 11.9, 11.10, 11.11, Appendices 17 and 18).

In August 2000, the PADEP conducted a ground water and surface water assessment at the SLC facility (Ref. 23, p. 3). During the assessment, ground water samples were collected from on-site monitoring

wells, nearby residential wells, and the Susquehanna River (Ref. 23, p. 3). Analytical results of the ground water samples indicated the presence of inorganic constituents and radionuclides at elevated concentrations (Ref. 23, Appendix B, Tables 3, 4, and 10). Surface water samples did not reveal elevated levels of hazardous substances (Ref. 23, Appendix B, Tables 5 and 6).

In 2001, the NRC, conducted a review and evaluation of the characterization data collected in 1995 (Ref. 6, p. 2). As part of the review and evaluation, the NRC conducted a site visit at the SLC facility to gather information regarding current site conditions (Ref. 6, p. 50). The review and evaluation report summarized the results of the 1995 site characterization and made recommendations for the collection of additional characterization data (Ref. 6, p. 2).

The facility currently is undergoing decommissioning under the NRC (Refs. 16; 17, pp. 1, A-1, A-2, A-3, B-i). Decommissioning plans, cost estimates, and characterization reports have been prepared to determine the remedial measures required to return the SLC facility to unrestricted use (Refs. 4, p. iii-1; 6, p. 1; 16, pp. 1, 2). On-site buildings have been surveyed, and on- and off-site sampling has been conducted (Refs. 4, pp. 21.1 through 12.57; 6, pp. 19 through 46). Based on the decommissioning cost estimates prepared, SLC is unable to finance the decommissioning of the facility. The NRC, the lead regulatory agency, is unable to conduct the decommissioning necessary to return SLC to unrestricted use. Therefore, the NRC requested assistance from EPA Region 3 with cleanup of SLC through NPL listing (Refs. 11; 17, p. 1).

## SOURCE DESCRIPTION

### 2.2 Source Characterization

Number of the source: 1

Name and description of the source: Two Underground Silos

HRS Source Type: Tanks or Nondrum containers

The underground silos were about 10 feet (ft) in diameter and 12 ft deep (Ref. 6, p. 78). The silos were cylindrical in shape and made of metal (Ref. 11), with concrete floors or bottoms and manholes for the cover (Refs. 4, Appendix 14; 9, p. 2-1). In the 1950s, the silos were used primarily as a disposal unit for radioactive wastes, including watch dials and surplus materials (Refs. 4, p. 10.1; 6, p. 78). In 2000, the silos were excavated and waste samples were collected from the contents of the silos and analyzed for total metals, total radionuclides, and Toxicity Characteristics Leaching Procedure (TCLP) metals, volatile and semivolatile organic compounds, and radionuclides (Refs. 11; 20; 21). The contents of the silos were placed in 176 55-gallon drums and 26 B-25 containers/boxes (Refs. 11; 21). The drums and B-25 containers/boxes currently are located on site in an area that is in the flood plain of the North Branch of the Susquehanna River (Refs. 11; 21; 25). The contents of the silos reportedly will be segregated and resampled for disposal at a licensed disposal facility (Ref. 11). Analyses of samples collected from the silos at the time of excavation indicate the presence of several radionuclides, including radium-226, cesium-137, and uranium, and inorganic constituents, including cadmium, chromium, lead, mercury, and silver. Samples collected from the silos failed TCLP for cadmium, copper, mercury, zinc, and chlorobenzene (Ref. 20).

Location of the source, with reference to a map of the site: The underground silos were located in the central portion of the SLC property (Ref. 23; p. 4). The underground silos were located about 180 feet from the North Branch of the Susquehanna River (Ref. 23, p. 4).

#### Containment

Release to ground water: Each silo was about 12 ft deep (Ref. 6, p. 78). Soils in the subsurface surrounding the silos are sandy soils (Ref. 6, p. 78). A liner was not present to prevent contamination in the silos from contaminating the ground water. Available file information indicates that the sides of the silos were deteriorated and ground water traveled through the silos while in the ground (Ref. 11). This information, applied to Table 3-2 of Reference 1, yields a containment value of 10 (Ref. 1, Section 3.1.2.1).

Release through overland migration or flood: The underground silos were located about 180 feet from the North Branch of the Susquehanna River (Ref. 23, p. 4). A leachate collection system was not in place to prevent contaminated ground water from the underground silos from entering the North Branch of the Susquehanna River. In 1972, the facility was flooded by about 10 feet of water (Ref. 24). The silos were located in the 100-year flood plain of the North Branch of the Susquehanna River (Ref. 25). Available file information does not indicate a cover or any flood containment structures associated with the silos. This information, applied to Table 4-2 of Reference 1, yields a containment value of 10 (Ref. 1, Sections 4.1.2.1.2.1.1 and 4.1.2.1.2.2.1).

#### 2.4.1 Hazardous Substances

##### Radionuclides

Waste samples listed in the table below were collected from the contents of the silos that were excavated in 2000 (Ref. 20, pp. 1 - 10). Samples CH-01-00-A, Silo 1 - 3 feet, and Silo 3 - 10 feet were collected by SLC and analyzed by Barringer Laboratories (Barringer) (Ref. 20, pp. 7 - 10, 50, 51, 58, 64). Samples SL-ESC-01 through SL-ESC-05 were collected by SLC and were analyzed by O'Brien & Gere Laboratories, Inc. (Ref. 20, pp. 2 - 6). Analytical data sheets and quality control (QC) information are contained in Reference 20, pp. 7 - 9, 42, 47, 50 - 53, 58, 64, 67, 68, 74, 76.

Radionuclide	Sample Number	Sample Concentration (pCi/g)	MDC (pCi/g)	References
Bismuth-214	SL-ESC-01 SL-ESC-02 SL-ESC-03 SL-ESC-04 CH-01-00-A	2,500 440 330 1,300 21,000	8.3 0.93 37 5.9 400	20, pp. 2, 3, 4, 10
Cesium-137	SL-ESC-01 SL-ESC-02 SL-ESC-03 SL-ESC-04 SL-ESC-05 CH-01-00-A	7.6 9.5 110,000 1,100 2,700,000 290,000	1.3 0.45 190 3.0 320 200	20, pp. 2, 3, 4, 5, 10
Francium-223	SL-ESC-04	180	9.4	20, p. 4
Lead-210	CH-01-00-A	48,000	4,000	20, p. 10
Lead-214	SL-ESC-01 SL-ESC-02 SL-ESC-03 SL-ESC-04 CH-01-00-A	2,700 470 480 740 18,000	3.0 1.0 60 7.6 500	20, pp. 2, 3, 4, 10
Potassium-40	CH-01-00-A	3,800	700	20, p. 10
Protactinium-231	SL-ESC-04	680	100	20, p. 4
Radium-223	SL-ESC-04	310	10	20, p. 4
Radium-224	SL-ESC-01 SL-ESC-02 SL-ESC-03 SL-ESC-04	5,000 830 680 1,200	240 8.5 422 60	20, pp. 2, 3, 4

<b>Radionuclide</b>	<b>Sample Number</b>	<b>Sample Concentration (pCi/g)</b>	<b>MDC (pCi/g)</b>	<b>References</b>
Radium-226	SL-ESC-02	990	9.5	20, pp. 3, 4, 5, 58, 64
	SL-ESC-03	30,000	410	
	SL-ESC-04	30,000	73	
	SL-ESC-05	36,000	4,300	
	Silo 1 - 3 feet	20,000	3	
	Silo 3 - 10 feet	400,000	9	
Thorium-231	SL-ESC-01	200	13	20, pp. 2, 3, 4
	SL-ESC-02	43	6.9	
	SL-ESC-03	1,000	180	
	SL-ESC-04	1,200	38	
Thorium-234	SL-ESC-04	260	59	20, p. 4
Uranium-235	SL-ESC-04	1,800	22	20, p. 4, 5
	SL-ESC-05	2,200	1,100	

Notes:

MDC = Minimum detected concentration

pCi/g = Picocuries per gram

SL = Safety Light Corporation

### Total Metals

Waste samples listed in the table below were collected from the contents of the silos that were excavated in 2000 (Ref. 20, pp. 50 - 52). Samples Silo 1 - 3 feet and Silo 3 - 10 feet were collected by SLC and analyzed by Barringer (Ref. 20, pp. 50 - 52). Analytical data sheets and QC information are contained in Reference 20, pp. 50 - 53, 57, 58, 64.

<b>Hazardous Substance</b>	<b>Sample Number</b>	<b>Sample Concentration (mg/kg)</b>	<b>MDL (mg/kg)</b>	<b>References</b>
Arsenic	Silo 1 - 3 feet	32	20	20, p. 57
Cadmium	Silo 1 - 3 feet Silo 3 - 10 feet	110 340	2	20, pp. 58, 64
Chromium	Silo 1 - 3 feet Silo 3 - 10 feet	29 37	2	20, pp. 58, 64
Lead	Silo 1 - 3 feet	110	20	20, p. 58
Selenium	Silo 3 - 10 feet	210	20	20, p. 64
Silver	Silo 1 - 3 feet Silo 3 - 10 feet	26 43	2	20, pp. 58, 64
Mercury	Silo 1 - 3 feet Silo 3 - 10 feet	1.7 0.70	0.1	20, pp. 64

Note:

MDL Method detection limit  
mg/kg = milligrams per kilogram

### TCLP Metals and Organic Compounds

Waste samples listed in the table below were collected from the contents of the silos that were excavated in 2000 (Ref. 20, pp. 43, 69 - 71). Samples East Silo Bottom 1, Silo 1 - 3 feet, and Silo 3 - 10 feet were collected by SLC and analyzed for TCLP by Barringer (Ref. 20, pp. 7 - 10, 42, 43, 50 - 52, ). Analytical data sheets and QC information are contained in Reference 20, pp. 42, 43, 65 - 71.

Hazardous Substance	Sample Number	Sample Concentration (mg/L)	TCLP Limit (mg/L)	References
Cadmium	East Silo Bottom 1 Silo 3 - 10 feet	4.8 2.2	0.03	20, pp. 43, 70
Copper	East Silo Bottom 1 Silo 3 - 10 feet	21 6.1	0.05	20, pp. 43, 70
Lead	East Silo Bottom 1	49	0.3	20, p. 43
Mercury	Silo 1 - 3 feet	0.0034	0.002	20, p. 69
Zinc	East Silo Bottom 1 Silo 1 - 3 feet Silo 3 - 10 feet	59 0.31 53	0.1	20, pp. 43, 69, 71
Chlorobenzene	Silo 1 - 3 feet	5.9 µg/L	5 µg/L	20, p. 69

Notes:

mg/L = Milligrams per liter

µg/L = Micrograms per liter

TCLP = Toxicity Characteristics Leaching Procedure

2.4.2. Hazardous Waste Quantity (non-radioactive hazardous substances)

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information is available to evaluate hazardous constituent quantity for non-radioactive hazardous substances.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate hazardous wastestream quantity for non-radioactive hazardous substances.

2.4.2.1.3. Volume

The underground silos were about 10 ft in diameter and 12 ft deep. The volume of the silos was determined by calculating the area of the horizontal cross section of the silos ( $3.14[r^2]$ ), then multiplying the area by the depth of the silos.  $3.14(5\text{ ft})^2 \times 12\text{ ft} = 942\text{ cubic feet (ft}^3\text{)}$ .  $942\text{ ft}^3 \div 27\text{ cubic yards (yd}^3\text{)/ft}^3 = 34.89\text{ yd}^3$ .  $34.89\text{ yd}^3 \times 2\text{ silos} = 69.78\text{ yd}^3$  (Ref. 6, p. 78). This information, applied to Table 2-5 of Reference 1, yields a source waste quantity value of 27.91 ( $69.78\text{ yd}^3 \div 2.5 = 27.91$ ) (Ref. 1, Section 2.4.2.1.3, Table 2-5).

Dimension of source (yd<sup>3</sup>): 69.78

References(s): 1, Table 2-5; 6, p. 78

Volume Assigned Value: 27.91

2.4.2.1.4 Area

Volume for non-radioactive wastes has been determined; therefore, the area of the source was not calculated (Ref. 1, p. 51591).

2.4.2.1.5. Source Hazardous Waste Quantity Value (non-radioactive hazardous substances)

Source Hazardous Waste Quantity Value (non-radioactive hazardous substances): 27.91

[Note: The HRS evaluates radioactive substances separately and differently from non-radioactive hazardous substances. For hazardous waste quantity, the HRS evaluates only two tiers for radioactive substances, as compared to four tiers for non-radioactive hazardous substances. The two tiers evaluated for radioactive substances correspond to the first two tiers for non-radioactive hazardous substances (Ref. 1, pp. 51663 through 51665).]

#### 7.2.5 Hazardous Waste Quantity (radioactive substances)

##### 7.2.5.1.1 Radionuclide Constituent Quantity

The underground silos were about 10 feet in diameter and 12 feet deep (Ref. 6, p. 78). The volume of the silos was determined by calculating the horizontal cross section of the silos ( $3.14[r^2]$ ), then multiplying the area by the depth of the silos.  $3.14(5\text{ ft})^2 \times 12\text{ ft} = 942\text{ ft}^3$ .  $942\text{ ft}^3 \div 27\text{ yd}^3/\text{ft}^3 = 34.89\text{ yd}^3$ .  $34.89\text{ yd}^3 \times 2\text{ silos} = 69.78\text{ yd}^3$  (Ref. 6, p. 78). Analyses of the contents of the silos indicated the presence of radionuclides (Ref. 20, pp. 1 - 79). The estimated activity content of radionuclides in the silos was determined to be 186.23 curies (Refs. 1, Section 7.2.5.1.1; 26). The curies of radionuclides was converted to the equivalent pounds (lb) of non-radioactive hazardous substances by multiplying by 1,000;  $186.23\text{ curies} \times 1,000 = 186,230\text{ lb}$  (Refs. 1, Section 7.2.5.1.1, Table 2-5; 26). The average or mean constituent waste quantity using the five samples collected from the silos was calculated as follows:  $186,230\text{ lb} \div 5 = 37,246\text{ lb}$  (Ref. 26).

Sum (lb): 37,246  
Hazardous Constituent Value (S): 37,246  
Reference(s): 1, Section 7.2.5.1.1; Table 2-5; 26

##### 7.2.5.1.2. Radionuclide Wastestream Quantity

Although radionuclide constituent quantity was evaluated, it is not adequately determined. Therefore, the radionuclide wastestream quantity is also evaluated (Ref. 1, pp. 51665, 51666). The total volume of Source No. 1 is  $69.78\text{ yd}^3$  (Refs. 6, p. 78; 26). Using the information in Reference 1, Section 7.2.5.1.2, the wastestream quantity for Source No. 1 is calculated as follows:  $69.78 \div 0.55 = 126.87$ .

##### 7.2.5.1.3 Source Hazardous Waste Quantity Value (radioactive substances)

The source hazardous waste quantity value for radioactive substances is based on the radionuclide constituent quantity value of 37,246 (Refs. 1, Table 2-5, Section 7.2.5.1.1; 6, p. 78; 26).

Source Hazardous Waste Quantity value (radioactive substances): 37,246

##### 7.2.5.3 Source Hazardous Waste Quantity Value (combined)

The combined source hazardous waste quantity value is the sum of the source hazardous waste quantity for non-radioactive hazardous substances and the source hazardous waste quantity value for radioactive substances:  $27.91 + 37,246 = 37,273.91$ .

Source Hazardous Waste Quantity Value (combined): 37,273.91

Number of the source: 2

Name and description of the source: East Lagoon

HRS Source Type: Surface Impoundment

The east lagoon is about 20 meters (m) from east to west and about 15 m from north to south (Ref. 36, p. 1). From 1948 to 1954, the east lagoon was used for the disposal of sewage and process wastewater from the radium laboratory in the main building (Refs. 4, p. 3.5; 6, p. 51). In 1960, the contents of the east lagoon were pumped into the west lagoon (Ref. 6, p. 51). During the May 2001 NRC site visit, an oily spot was observed in the middle of the base of the east lagoon (Ref. 6, pp. 50, 51). Also, an 8- or 10-inch diameter outfall was observed in the east lagoon; however, the outfall was dry at the time of the site visit (Ref. 6, p. 51). In October 1999, the NRC, conducted surface water and sediment sampling of the east lagoon. At the time of sampling, the bottom of the east lagoon was filled with about 10 to 15 centimeters (cm) (3.94 to 5.91 inches) of water (Ref. 36, p. 1). During both the NRC visits, the slopes of the lagoon were overgrown with vegetation (Refs. 6, p. 51; 36, p. 1).

During the NRC investigation in 1999, 19 sediment and one surface water sample were collected from the east lagoon. The sediment samples were collected from various depths from 0 to 93 cm (0 to 36.61 inches) (Ref. 36, pp. 2, 7, 8). Analytical results of sediment samples indicated the presence of the following radionuclides: americium-241, less than ( $<$ )  $0.11$  to  $4.35 \pm 0.38$  pCi/g; radium-226,  $4.7 \pm 1.0$  to  $2,540 \pm 540$  pCi/g; cesium-137,  $1.61 \pm 0.11$  to  $519 \pm 24$  pCi/g; and strontium-90,  $1.10 \pm 0.40$  to  $186.4 \pm 0.42$  pCi/g (Ref. 36, pp. 7, 8). Radionuclide concentrations in the surface water sample ranged from: americium-241,  $<7.33$  pCi/L; radium-226,  $0.27$  pCi/L; cesium-137,  $<6.08$  pCi/L; strontium-90,  $1.27$  pCi/L; and tritium,  $9,000$  pCi/L (Ref. 36, p. 3). Sample collection and analytical procedures are outlined in References 54 and 55.

Location of the source, with reference to a map of the site: The east lagoon is located in the south-central portion of the SLC property, and about 175 feet from the bank of the North Branch of the Susquehanna River (Refs. 4, p. 3-4; 23, Figure 2).

#### Containment

Release to ground water: Available file information does not indicate the presence of a liner below the east lagoon (Ref. 6, p. 51). This information, applied to Table 3-2 of Reference 1, yields a containment value of 10 (Ref. 1, Section 3.1.2.1)

Release through overland migration or flood: The east lagoon is located about 175 feet from the bank of the North Branch of the Susquehanna River (Ref. 23, p. 4). This location is in the 100-year flood plain of the river (Ref. 25). In 1972, the Susquehanna River flooded and the contents of the east lagoon reportedly were dispersed during the flood (Refs. 4, p. 3.7; 6, p. 51; 24; 25). Also, there is no runoff management system located around the east lagoon to prevent the uncontrolled flow of hazardous substances from entering the North Branch of the Susquehanna River. This information, applied to Table 4-2 of Reference 1, yields a containment value of 10 (Ref. 1, Sections 4.1.2.1.2.1.1 and 4.1.2.1.2.2.1).

#### 2.4.1 Hazardous Substances

##### **Radionuclides**

The waste water sample listed in the table below was collected in 1981 by the NRC (Ref. 10, p. 1). Sample W3 was collected from the east lagoon and analyzed for radionuclides, including radium-226, strontium-90, and tritium (Ref. 10, pp. 39, 41). As indicated in the footnotes at the bottom of Table 4 of the NRC report, the uncertainty is two standard deviations ( $2\sigma$ ) (Ref. 10, p. 41). Analytical procedures are contained in Reference 10, Appendix B.

<b>Radionuclide</b>	<b>Sample Number</b>	<b>Sample Concentration (<math>\mu\text{Ci/mL}</math>)</b>	<b>Uncertainty (<math>\mu\text{Ci/mL}</math>)</b>	<b>References</b>
Radium-226	W3	$3.0 \times 10^{-10}$	$\pm 1.8 \times 10^{-10}$	10, pp. 13, 41
Tritium	W3	$7.14 \times 10^{-6}$	$\pm 0.49 \times 10^{-6}$	10, pp. 13, 41

Notes:

$\mu\text{Ci/mL}$  = Microcuries per milliliter

W3 = Surface water sample from east lagoon

$\pm$  = Uncertainty

### Target Analyte List Metals

The waste sample listed in the table below was collected in 1993 from the east lagoon by EPA (Ref. 28, Attachment 4, p. 5). The depth of the sample is not provided in the available file information (Ref. 28, p. 2). Analytical data sheets are contained in Reference 28, Attachment 4, pp. 1 - 15; data validation information is contained in Reference 28, Attachment 1, pp. 1, 3.

Hazardous Substance	Sample Number	Sample Concentration (mg/kg)	Reporting Limit (mg/kg)	References
Antimony	SS03	77.3	16.6	28, Attachment 4, pp. 5, 19
Cadmium	SS03	80.4	1.4	28, Attachment 4, pp. 5, 19
Chromium	SS03	1,280	2.8	28, Attachment 4, pp. 5, 19
Copper	SS03	364	6.9	28, Attachment 4, pp. 5, 19
Cyanide	SS03	10.8	2.9	28, Attachment 4, pp. 5, 8
Lead	SS03	237	24.8	28, Attachment 4, pp. 5, 19
Mercury	SS03	0.8	0.29	28, Attachment 4, pp. 5, 19
Nickel	SS03	158	11	28, Attachment 4, pp. 45, 19
Selenium	SS03	54.2	12.5	28, Attachment 4, pp. 5, 19
Silver	SS03	292	2.8	28, Attachment 4, pp. 5, 19
Zinc	SS03	892	5.5	28, Attachment 4, pp. 5, 19

Notes:

mg/kg = Milligrams per kilogram

SS = Soil sample

2.4.2. Hazardous Waste Quantity (non-radioactive hazardous substances)

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information is available to evaluate hazardous constituent quantity for non-radioactive hazardous substances.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate hazardous wastestream quantity for non-radioactive hazardous substances.

2.4.2.1.3. Volume

Insufficient information is available to evaluate volume for non-radioactive hazardous substances.

2.4.2.1.4 Area

The east lagoon is about 20 m from east to west and about 15 m from north to south (Ref. 36, p. 1). The area of the east lagoon was determined as follows: 20 m x 3.281 feet (ft)/meter = 65.62 ft; 15 m x 3.281 ft/m = 49.22 ft. Therefore, 65.62 ft x 49.22 ft = 3,229.8 square feet (ft<sup>2</sup>). This information, applied to Table 2-5 of Reference 1 (3,229.8 ft<sup>2</sup> ÷ 13 = 248.45), yields a source area waste quantity value of 248.45.

Area of source (ft<sup>2</sup>): 3,229.8

Reference(s):1, Table 2-5; 36, p. 1

Area Assigned Value: 248.45

2.4.2.1.5. Source Hazardous Waste Quantity Value (non-radioactive hazardous substances)

Source Hazardous Waste Quantity Value (non-radioactive hazardous substances): 248.45

7.2.5 Hazardous Waste Quantity (radioactive substances)

7.2.5.1.1 Radionuclide Constituent Quantity

Insufficient information is available to evaluate radionuclide constituent quantity for Source No. 2.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate radionuclide wastestream quantity for Source No. 2.

7.2.5.1.3 Source Hazardous Waste Quantity Value (radioactive substances)

Source Hazardous Waste Quantity value (radioactive substances): Not evaluated

7.2.5.3 Source Hazardous Waste Quantity Value (combined)

The combined source hazardous waste quantity value is the sum of the source hazardous waste quantity for non-radioactive hazardous substances and the source hazardous waste quantity value for radioactive substances:  $248.45 + 0 = 248.45$ .

Source Hazardous Waste Quantity Value (combined): 248.45

Number of the source: 3

Name and description of the source: West Lagoon

HRS Source Type: Surface Impoundment

The west lagoon has an area of about 750 square feet (ft<sup>2</sup>) (Ref. 9, p. 2-1). The west lagoon was used for the disposal of liquid waste including silver plating wastes and anodizing solutions (Ref. 6, p. 51). In 1960, the contents of the east lagoon were pumped into the west lagoon (Ref. 6, p. 51). Also, low-level radioactive waste reportedly was buried in the west lagoon (Ref. 9, p. 2-1). During the NRC 2001 site visit, no accumulation of liquid or debris was observed in the west lagoon (Ref. 6, p. 51).

Location of the source, with reference to a map of the site: The west lagoon is located in the south-central portion of the SLC property, near the western property line and about 175 feet from the bank of the North Branch of the Susquehanna river (Refs. 4, p. 3-4; 23, Figure 2).

#### Containment

Release to ground water: Available file information does not indicate the presence of a liner below the west lagoon (Ref. 6, p. 51). This information, applied to Table 3-2 of Reference 1, yields a containment value of 10 (Ref. 1, Section 3.1.2.1).

Release through overland migration or flood: The west lagoon is located about 175 feet from the bank of the North Branch of the Susquehanna River (Ref. 23, p. 4). This location is in the 100-year flood plain of the river (Ref. 25). In 1972, the Susquehanna River flooded and the contents of the west lagoon reportedly were dispersed during the flood (Refs. 6, p. 51; 24; 25). Also, there is no runoff or runoff management system located around the west lagoon to prevent the uncontrolled flow of hazardous substances from entering the North Branch of the Susquehanna River. The available file information does not indicate the presence of a cover or flood containment structures associated with the west lagoon. This information, applied to Table 4-2 of Reference 1, yields a containment value of 10 (Ref. 1, Sections 4.1.2.1.2.1.1 and 4.1.2.1.2.2.1).

#### 2.4.1 Hazardous Substances

##### **TAL Metals**

The soil sample listed in the table below was collected from the west lagoon by EPA in 1993 (Ref. 28, Attachment 4, p. 5). The depth of the sample is not provided in the available file information (Ref, 28, p. 2). Analytical data sheets are contained in Reference 28, Attachment 4, pp. 1 - 15; data validation information is contained in Reference 28, Attachment 1, pp. 1, 3.

<b>Hazardous Substance</b>	<b>Sample Number</b>	<b>Sample Concentration (mg/kg)</b>	<b>Reporting Limit (mg/kg)</b>	<b>References</b>
Cadmium	SS04	8.0	2.2	28, Attachment 4, pp. 5, 20
Chromium	SS04	1,920	4.4	28, Attachment 4, pp. 5, 20
Copper	SS04	3,400	11	28, Attachment 4, pp. 5, 20
Lead	SS04	442	39.2	28, Attachment 4, pp. 5, 20
Mercury	SS04	2.6	0.45	28, Attachment 4, pp. 5, 20
Nickel	SS04	352	17.7	28, Attachment 4, pp. 5, 20
Selenium	SS04	4.1	2.2	28, Attachment 4, pp. 5, 20
Silver	SS04	941	4.4	28, Attachment 4, pp. 5, 20

Notes:

mg/kg = Milligrams per kilogram  
SS = Soil sample

2.4.2. Hazardous Waste Quantity (non-radioactive hazardous substances)

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information is available to evaluate hazardous constituent quantity for non-radioactive hazardous substances.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate hazardous wastestream quantity for non-radioactive hazardous substances.

2.4.2.1.3. Volume

Insufficient information is available to evaluate volume for non-radioactive hazardous substances.

2.4.2.1.4. Area

The west lagoon is about 750 ft<sup>2</sup> (Ref. 9, p. 2-1). This information applied to Table 2-5 of Reference 1 (750 ft<sup>2</sup> ÷ 13 = 57.69), yields a source waste quantity of 57.69.

Area of source (ft<sup>2</sup>): 750

Reference(s):1, Table 2-5; 9, p. 2-1

Area Assigned Value: 57.69

2.4.2.1.5. Source Hazardous Waste Quantity Value (non-radioactive hazardous substances)

Source Hazardous Waste Quantity Value: 57.69

7.2.5 Hazardous Waste Quantity (radioactive substances)

7.2.5.1.1 Radionuclide Constituent Quantity

Insufficient information is available to evaluate radionuclide constituent quantity for Source No. 3.

7.2.5.1.2. Radionuclide Wastestream Quantity

Insufficient information is available to evaluate the radionuclide wastestream quantity for Source No. 3.

7.2.5.1.3 Source Hazardous Waste Quantity Value (radioactive substances)

Source Hazardous Waste Quantity value (radioactive substances): Not evaluated

7.2.5.3 Source Hazardous Waste Quantity Value (combined)

The combined source hazardous waste quantity value is the sum of the source hazardous waste quantity for non-radioactive hazardous substances and the source hazardous waste quantity value for radioactive substances:  $57.69 + 0 = 57.69$ .

Source Hazardous Waste Quantity Value (combined): 57.69  
Reference: 1, Table 2-5

Number of the source: 4

Name and description of the source: Contaminated Soil throughout the Facility Property

HRS Source Type: Contaminated Soil

Source No. 4 is an unquantified area of contaminated soil located throughout the facility property (Refs. 10, pp. 27, 28, 43 - 47; 28, Attachment 3, Attachment 4, pp. 18, 21, 22, 23). The soil became contaminated as a result of several disposal areas located throughout the facility property, three of which include an abandoned canal and two disposal pits (also called east and west plant dumps ) (Refs. 6, pp. 50, 51; 9, pp. 2-1, 4-1; 10, pp. 2, 3). The abandoned canal was used for the disposal of radium-226-contaminated ductwork and liquid waste from radiological production activities (Refs. 4, pp. 3.5, 3.6; 6, pp. 50, 51, 78). The east plant dump encompasses areas between the east and west lagoons, and was identified in 1972 during the installation of a storm sewer (Ref. 6, p. 51). The west plant dump is adjacent to the western property line and fence (Ref. 6, p. 51). During the May 2001 NRC site visit, the east plant dump contained piles of pallets, old chain-link fences, old pipes, windows, cinder blocks, and sheet metal. In 1948 and 1949, the west plant dump was used for the disposal of solid waste. The west plant dump also was used for the disposal of radium-226 dials and strontium-90 deck markers. During the May 2001 NRC site visit, SLC personnel indicated that from time to time, radium dials are still found in the west plant dump (Ref. 6, pp. 51, 79). A ground penetrating radar survey conducted during the 1995 SLC site characterization revealed reflections that are characteristic of metallic objects and drums on the northern, eastern, and western sides of the west plant dump (Ref. 6, pp. 52, 79). Analytical results of samples collected from these areas throughout the facility property indicated the presence of radiological and nonradiological contamination at elevated concentrations (Refs. 10, pp. 43 - 47; 28, Attachment 4, pp. 8, 18, 21, 22, 23).

Location of the source, with reference to a map of the site: Source No. 4 is an unquantified area of contaminated soil located throughout the southern portion of the facility property from the eastern to western property boundaries (Ref. 10, pp. 27, 28, 37, 43 - 47; 28, Attachment 3).

#### Containment

Release to ground water: Available file information does not indicate the presence of a liner below the area that encompasses Source No. 4 (Ref. 6, pp. 50, 51). This information, applied to Table 3-2 of Reference 1, yields a containment value of 10 (Ref. 1, Section 3.1.2.1)

Release through overland migration or flood: The area that encompasses Source No. 4 is located in the flood plain of the North Branch of the Susquehanna River (Ref. 25). In March 1979, areas in the flood plain of the river were flooded (Ref. 18, p. 37). Also, there is no runoff or runoff management system to prevent the uncontrolled flow of hazardous substances in Source No. 4 from entering the North Branch of the Susquehanna River. Available file information does not indicate the presence of a cover or flood containment structures associated with Source No. 4. This information, applied to Table 4-2 of Reference 1, yields a containment value of 10 (Ref. 1, Sections 4.1.2.1.2.1.1 and 4.1.2.1.2.2.1).

#### 2.4.1 Hazardous Substances

##### Radionuclides

The soil samples listed in the table below were collected in June and August 1981 by the NRC (Ref. 10, p. 1). Samples were collected from boreholes installed throughout the SLC property (Ref. 10, pp. 7, 8, 27, 28). Depths of surface soil samples are not provided in the file information (Ref. 10, p. 7). Depths of subsurface soil samples are provided in parentheses next to the borehole numbers (Ref. 10, pp. 45 - 47). Soil samples were compared to baseline soil samples collected from areas located 2.5 and 10 km from the SLC facility (Ref. 10, pp. 10, 34). As indicated in the footnotes at the bottom of Tables 6 and 7 of the NRC report, the uncertainty is reported as  $2\sigma$  (Ref. 10, pp. 44, 47). Radium-226 is the only naturally occurring radionuclide used at SLC. Cesium-137, strontium-90, and tritium are not naturally occurring (Ref. 11, p. 3). Analytical data sheets and detection limits are not available for the samples listed in the table below (Ref. 10). Therefore, the determination of elevated concentrations for cesium-137, strontium-90, and tritium, is based on the criteria for naturally occurring radionuclides, which is  $2\sigma$  above the mean background concentration for the radionuclide. This method is more conservative than the method for man-made radionuclides, which is any concentration above the sample quantitation limit for the radionuclide (Ref. 1, Section 7.1.1; 27, p. 9).

Borehole Number (depth)	Radionuclide	Sample Concentration (pCi/g)	Uncertainty (pCi/g)	References
3	Cesium-137	1.06	$\pm 0.08$	10, pp. 27, 43
4	Radium-226	2.34	$\pm 0.14$	10, pp. 27, 43
6	Cesium-137	1.77	$\pm 0.10$	10, pp. 27, 43
8	Radium-226 Cesium-137	4.17 1.02	$\pm 0.18$ $\pm 0.10$	10, pp. 27, 43
9	Cesium-137	2.28	$\pm 0.11$	10, pp. 27, 43
10	Radium-226 Cesium-137 Strontium-90	2.12 304 4.68	$\pm 0.45$ $\pm 1$ $\pm 0.42$	10, pp. 27, 43
11	Radium-226 Cesium-137 Strontium-90	1.19 14.8 5.31	$\pm 0.19$ $\pm 0.3$ $\pm 0.37$	10, pp. 27, 43
15	Cesium-137	1.34	$\pm 0.10$	10, pp. 27, 43
16	Radium-226 Cesium-137	2.99 1.95	$\pm 0.17$ $\pm 0.12$	10, pp. 27, 43
20	Radium-226 Cesium-137	1.71 1.22	$\pm 0.16$ $\pm 0.11$	10, pp. 27, 43
21	Radium-226	1.03	$\pm 0.12$	10, pp. 27, 43

Borehole Number (depth)	Radionuclide	Sample Concentration (pCi/g)	Uncertainty (pCi/g)	References
22	Radium-226 Cesium-137 Strontium-90	1.21 11.8 11.7	$\pm 0.15$ $\pm 0.3$ $\pm 2.1$	10, pp. 27, 43
24	Cesium-137	1.68	$\pm 0.11$	10, pp. 27, 43
25	Radium-226 Cesium-137	2.06 3.01	$\pm 0.15$ $\pm 0.14$	10, pp. 27, 43
26	Radium-226 Cesium-137 Strontium-90	1.34 19.5 6.85	$\pm 0.16$ $\pm 0.3$ $\pm 0.68$	10, pp. 27, 43
27	Cesium-137	3.81	$\pm 0.17$	10, pp. 27, 43
28	Cesium-137	10.9	$\pm 0.3$	10, pp. 27, 43
29	Radium-226 Cesium-137	5.78 1.33	$\pm 0.22$ $\pm 0.11$	10, pp. 27, 43
31	Strontium-90	1.50	$\pm 0.32$	10, pp. 27, 44
33	Cesium-137	1.24	$\pm 0.09$	10, pp. 27, 43
35	Strontium-90	10.3	$\pm 0.4$	10, pp. 27, 43
39	Radium-226	1.29	$\pm 0.10$	10, pp. 27, 43
40B	Radium-226 Cesium-137	67.1 2.77	$\pm 0.09$ $\pm 0.28$	10, pp. 27, 43
41B	Radium-226 Cesium-137	220 4.79	$\pm 1$ $\pm 0.36$	10, pp. 27, 44
42B	Cesium-137	3.28	$\pm 0.14$	10, pp. 27, 44
43B	Radium-226 Cesium-137	353 8.2	$\pm 2$ $\pm 0.5$	10, pp. 27, 44
44B	Radium-226 Cesium-137 Strontium-90	11.8 21.6 4.3	$\pm 0.4$ $\pm 0.4$ $\pm 0.6$	10, pp. 27, 44
45B	Radium-226 Cesium-137 Strontium-90	672 227 1.2	$\pm 9$ $\pm 1$ $\pm 0.3$	10, pp. 27, 44
46B	Radium-226 Cesium-137 Strontium-90	22 631 15.4	$\pm 0.8$ $\pm 2$ $\pm 0.4$	10, pp. 27, 44

Borehole Number (depth)	Radionuclide	Sample Concentration (pCi/g)	Uncertainty (pCi/g)	References
4 (0.3 m)	Radium-226 Tritium	1.6 1.7	$\pm 0.1$ $\pm 0.3$	10, pp. 28, 45
6 (3 m)	Strontium-90	1.6	$\pm 0.6$	10, pp. 28, 45
8 (1 m)	Radium-226	2.5	$\pm 0.2$	10, pp. 28, 45
8 (1.5 m)	Radium-226 Cesium-137	1.7 1.1	$\pm 0.1$ $\pm 0.1$	10, pp. 28, 45
8 (2.3 m)	Radium-226	1.6	$\pm 0.1$	10, pp. 28, 45
9 (2.7 m)	Tritium	3.1	$\pm 0.3$	10, pp. 28, 45
9 (3.6 m)	Strontium-90	1.5	$\pm 0.3$	10, pp. 28, 45
10 (0.3 m)	Radium-226 Cesium-137	1.9 286	$\pm 0.4$ $\pm 1$	10, pp. 28, 45
11 (0.3 m)	Cesium-137	3.1	$\pm 0.2$	10, pp. 28, 45
11 (0.9 m)	Cesium-137	1.7	$\pm 0.1$	10, pp. 28, 45
13 (0.3 m)	Cesium-137	1.7	$\pm 0.1$	10, pp. 28, 45
14 (1 m)	Cesium-137	1.4	$\pm 0.1$	10, pp. 28, 45
15 (0.3 m)	Cesium-137	2.1	$\pm 0.1$	10, pp. 28, 46
16 (0.3 m)	Radium-226 Cesium-137	3.8 2.5	$\pm 0.2$ $\pm 0.1$	10, pp. 28, 46
16 (1 m)	Radium-226 Cesium-137	19.8 21.7	$\pm 0.5$ $\pm 0.04$	10, pp. 28, 46
17 (0.3 m)	Cesium-137	0.97	$\pm 0.08$	10, pp. 28, 46
18 (1 m)	Radium-226 Cesium-137	18.9 44.0	$\pm 0.4$ $\pm 0.5$	10, pp. 28, 46
19 (0.3 m)	Cesium-137	1.1	$\pm 0.1$	10, pp. 28, 46
19 (1 m)	Radium-226	1.2	$\pm 0.1$	10, pp. 28, 46
20 (0.3 m)	Radium-226	1.5	$\pm 0.1$	10, pp. 28, 46
20 (0.6 m)	Radium-226	1.5	$\pm 0.1$	10, pp. 28, 46
21 (0.3 m)	Radium-226 Cesium-137 Strontium-90	4.6 6.5 1.3	$\pm 0.2$ $\pm 0.2$ $\pm 0.2$	10, pp. 28, 46

Borehole Number (depth)	Radionuclide	Sample Concentration (pCi/g)	Uncertainty (pCi/g)	References
21 (1 m)	Radium-226 Cesium-137	1.8 2.7	$\pm 0.1$ $\pm 0.1$	10, pp. 28, 46
22 (0.3 m)	Radium-226 Cesium-137	7.1 10.0	$\pm 0.3$ $\pm 0.3$	10, pp. 28, 46
22 (1 m)	Radium-226 Cesium-137 Strontium-90	3.5 2.0 13.3	$\pm 0.2$ $\pm 0.1$ $\pm 0.7$	10, pp. 28, 46
24 (0.8 m)	Radium-226 Cesium-137	1.9 1.6	$\pm 0.2$ $\pm 0.1$	10, pp. 28, 46
25 (1 m)	Cesium-137	0.97	$\pm 0.08$	10, pp. 28, 46
27 (0.3 m)	Cesium-137	1.0	$\pm 0.1$	10, pp. 28, 47
28 (0.3 m)	Cesium-137	13.7	$\pm 0.2$	10, pp. 28, 47
28 (0.8 m)	Cesium-137	8.3	$\pm 0.2$	10, pp. 13, 47
29 (0.3 m)	Radium-226	4.1	$\pm 0.2$	10, pp. 13, 47

Notes:

B = Biased sampling location  
pCi/g = Picocuries per gram  
( ) = Depth of subsurface soil sample  
m = Meters  
 $\pm$  = Uncertainty

## Background Concentrations

The mean background concentration and the standard deviation for each radionuclide were calculated for the baseline soil samples collected during the 1981 NRC investigation (Ref. 10, p. 39; 27, pp. 2, 3, 4, 5). The criteria of two standard deviations above mean background concentrations for naturally occurring radionuclides (radium-226) is presented in the table below for radionuclides detected in baseline soil samples (Ref. 27, p. 9). Analytical data sheets and detection limits are not available for the samples listed in the table below (Ref. 10). Therefore, the determination of elevated concentrations for cesium-137, strontium-90, and tritium is based on the criteria for naturally occurring radionuclides (Ref. 27, p. 9).

<b>Radionuclide</b>	<b>Mean Background Concentration (pCi/g)</b>	<b>Two Standard Deviations (pCi/g)</b>	<b>Reference</b>
Radium-226	0.48	$0.23 \times 2 = 0.46$	10, p. 39; 27, pp. 2, 3, 9
Cesium-137	0.26	$0.26 \times 2 = 0.52$	10, p. 39; 27, pp. 2, 4, 9
Strontium-90 <sup>1</sup>	0.63	$0.21^2$	10, p. 39
Tritium	0.45	$0.08 \times 2 = 0.16$	10, p. 39; 27, pp. 2, 5, 9

<sup>1</sup> = The concentration for strontium-90 is based on one sample

<sup>2</sup> = Two standard deviations provided in Table 2 of Reference 10

pCi/g = Picocuries per gram

## TAL Metals

The soil samples listed in the table below were collected by EPA in 1993 (Ref. 28, Attachment 4, p. 5). Depths of the samples are not provided in the available file information (Ref. 28, p. 2). Soil samples were compared to background soil sample SS01, collected near the bank of the North Branch of the Susquehanna River, in the southeastern corner of the facility property (Ref. 28, Attachment 3). Analytical data sheets and data validation information are contained in Reference 28, Attachment 4, pp. 4 - 15.

Hazardous Substance	Sample Number	Sample Concentration (mg/kg)	Reporting Limit (mg/kg)	References
Cadmium	SS05 SS06 SS07	18.3 240 31.6	3.7 0.65 0.49	28, Attachment 4, pp. 21, 22, 23
Chromium	SS05 SS06	79.1 124	1.5 1.3	28, Attachment 4, pp. 21, 22
Copper	SS05 SS06	185 590	3.7 3.2	28, Attachment 4, pp. 21, 22
Cyanide	SS06	15.7	2.7	28, Attachment 4, p. 8
Lead	SS05	221	14.7	28, Attachment 4, pp. 21
Mercury	SS05 SS06	7.7 0.95	0.15 0.13	28, Attachment 4, pp. 21, 22
Nickel	SS07	86.1	3.9	28, Attachment 4, p. 23
Selenium	SS06	12.6	1.3	28, Attachment 4, p. 22
Silver	SS02 SS05 SS06 SS07	4.1 35.1 101 43	1.8 7.3 1.3 0.99	28, Attachment 4, pp. 18, 21, 22, 23
Zinc	SS06 SS07	854 307	2.6 2.0	28, Attachment 4, pp. 22, 23

Notes:

mg/kg = Milligrams per kilogram

SS = Soil sample

Background Concentrations

<b>Hazardous Substance</b>	<b>Sample Number</b>	<b>Sample Concentration (mg/kg)</b>	<b>Reporting Limit (mg/kg)</b>	<b>References</b>
Cadmium	SS01	1.4	1.2	28, pp. 5, 17
Chromium	SS01	14.9	2.3	28, pp. 5, 17
Copper	SS01	20.1	5.8	28, pp. 5, 17
Cyanide	SS01	2.3U	2.3	28, pp. 5, 8
Lead	SS01	40.7	5.3	28, pp. 5, 17
Mercury	SS01	0.23U	0.23	28, pp. 5, 17
Nickel	SS01	23.6	9.2	28, pp. 5, 17
Selenium	SS01	1.1U	1.1	28, pp. 5, 17
Silver	SS01	2.3U	2.3	28, pp. 5, 17
Zinc	SS01	97.1	4.6	28, pp. 5, 17

Notes:

mg/kg = Milligrams per kilogram

SS = Soil sample

U = Not detected, the concentration reported is the sample detection limit

2.4.2. Hazardous Waste Quantity (non-radioactive hazardous substances)

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information is available to evaluate hazardous constituent quantity for non-radioactive hazardous substances.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate hazardous wastestream quantity for non-radioactive hazardous substances.

2.4.2.1.3. Volume

Insufficient information is available to evaluate the volume quantity for non-radioactive hazardous substances.

2.4.2.1.4. Area

Source No. 4 is an unquantified area of contaminated soil. The area encompasses much of the property south of the on-site buildings, and includes the abandoned canal, the east and west plant dumps, and areas in the flood plain of the North Branch of the Susquehanna River (Refs. 10, pp. 43 - 47; 28, Attachments 3 and 4).

Area of source (ft<sup>2</sup>): >0

Reference(s): 10, pp. 43 - 47; 28, Attachments 3 and 4

Area Assigned Value: >0

2.4.2.1.5. Source Hazardous Waste Quantity Value (non-radioactive hazardous substances)

Source Hazardous Waste Quantity Value (non-radioactive hazardous substances): >0

7.2.5 Hazardous Waste Quantity (radioactive substances)

7.2.5.1.1 Radionuclide Constituent Quantity

Insufficient information is available to evaluate radionuclide constituent quantity for Source No. 4.

7.2.5.1.2. Radionuclide Wastestream Quantity

Insufficient information is available to evaluate radionuclide wastestream quantity for Source No. 4.

7.2.5.1.3 Source Hazardous Waste Quantity Value (radioactive substances)

Source Hazardous Waste Quantity value (radioactive substances): Not evaluated

7.2.5.3 Source Hazardous Waste Quantity Value (combined)

The combined source hazardous waste quantity value is the sum of the source hazardous waste quantity for non-radioactive hazardous substances and the source hazardous waste quantity value for radioactive substances:  $>0 + 0 = 0$ .

Source Hazardous Waste Quantity Value (combined):  $>0$   
Reference(s): 1, Table 2-5

Number of the source: 5

Name and description of the source: Liquid Waste Tanks

HRS Source Type: Tanks

Source No. 5 is four 2,400-gallon aboveground storage tanks (AST) that are housed in the Liquid Waste Building (Refs. 4, p. 12.49; 6, p. 28). Tritium-contaminated wastewater from the Tritium or Nuclear Building is transported to the Liquid Waste Building through a below-grade drain line and enters a concrete sump that is about 7 feet deep. The wastewater is then pumped into one of the 2,400-gallon ASTs for dilution (Refs. 4, p. 12.49; 6, p. 28). The tritium-contaminated wastewater is diluted to a concentration of  $3 \times 10^{-3} \mu\text{Ci/mL}$ , then is released to the North Branch of the Susquehanna River (Refs. 10, p. 13; 29, p. 2).

Location of the source, with reference to a map of the site: Source No. 5 is located in the central portion of the SLC facility property, inside of the Liquid Waste Building (Ref. 23, p. 4).

#### Containment

Release to ground water: Wastewater is transported through below-grade drain lines prior to being pumped into the liquid waste tanks (Refs. 4, p. 12.49; 6, p. 28). Available file information does not indicate whether a liner is present below the building or under the drain lines to prevent contamination from reaching ground water. This information, applied to Table 3-2 of Reference 1, yields a containment value of 10 (Ref. 1, Section 3.1.2.1).

Release through overland migration or flood: Source No. 5 is located in an area that is within the 100-year flood plain of the North Branch of the Susquehanna River (Ref. 25). This information, applied to Table 4-2 of Reference 1, yields a containment value of 10 (Ref. 1, Sections 4.1.2.1.2.1.1 and 4.1.2.1.2.2.1).

#### 2.4.1 Hazardous Substances

The liquid waste tanks are used to store wastewater that contains tritium (Ref. 6, p. 28). The tritium-contaminated wastewater is diluted in the liquid waste tanks. Once an acceptable concentration is reached, the wastewater is discharged to the North Branch of the Susquehanna River through National Pollutant Discharge Elimination System (NPDES) Permit No. 0111848 (Ref. 4, p. 12.49). In 1981, the NRC collected a water sample (W1) from one of the liquid waste tanks; the sample was analyzed for tritium (Ref. 10, pp. 13, 41). Sample W1 was compared to the baseline water samples collected from areas located about 2.5 and 10 km from the SLC facility (Ref. 10, pp. 10, 34).

<b>Radionuclide</b>	<b>Sample Number</b>	<b>Sample Concentration (<math>\mu\text{Ci/mL}</math>)</b>	<b>Standard Deviation (<math>\mu\text{Ci/mL}</math>)</b>	<b>References</b>
Tritium	W1	$4.1 \times 10^{-2}$	$0.1 \times 10^{-2}$	10, pp. 13, 41
	W1	$3.7 \times 10^{-2}$	Not reported	

Notes:

$\mu\text{Ci/mL}$  = Microcuries per milliliter

W1 = Surface water sample from liquid waste tank

2.4.2. Hazardous Waste Quantity (non-radioactive hazardous substances)

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information is available to evaluate hazardous constituent quantity for non-radioactive hazardous substances.

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information is available to evaluate hazardous wastestream quantity for non-radioactive hazardous substances.

2.4.2.1.3. Volume

The combined volume of Source No. 5, the liquid waste tanks is 9,600 gallons (Refs. 6, p, 28; 4, p. 12.49).  
 $9,600 \text{ gallons} \div 200 \text{ gallons/yd}^3 = 48 \text{ yd}^3$ .  $48 \text{ yd}^3 \div 2.5 = 19.2$  (Ref. 1, Table 2-5).

Dimension of source (yd<sup>3</sup>): 48

References(s): 1, Table 2-5; 4, p. 12.49; 6, p. 28

Volume Assigned Value: 19.2

2.4.2.1.4 Area

Volume for non-radioactive wastes was determined; therefore, the area of the source was not calculated (Ref. 1, p. 51591).

2.4.2.1.5. Source Hazardous Waste Quantity Value (non-radioactive hazardous substances)

Source Hazardous Waste Quantity Value (non-radioactive hazardous substances): 19.2

7.2.5 Hazardous Waste Quantity (radioactive substances)

7.2.5.1.1 Radionuclide Constituent Quantity

Insufficient information is available to evaluate radionuclide constituent quantity for Source No. 5.

7.2.5.1.2. Radionuclide Wastestream Quantity

Insufficient information is available to evaluate radionuclide wastestream quantity.

7.2.5.1.3 Source Hazardous Waste Quantity Value (radioactive substances)

Source Hazardous Waste Quantity value (radioactive substances): Not evaluated

7.2.5.3 Source Hazardous Waste Quantity Value (combined)

The combined source hazardous waste quantity value is the sum of the source hazardous waste quantity for non-radioactive hazardous substances and the source hazardous waste quantity value for radioactive substances:  $19.2 + 0 = 19.2$

Source Hazardous Waste Quantity Value (combined): 19.2  
Reference(s): 1, Table 2-5

### SITE SUMMARY OF SOURCE DESCRIPTIONS

Source Number	Source Hazardous Waste Quantity Value	Containment			
		Ground water	Surface Water	Gas	Air Particulate
1	37,273.91	10	10	NS	NS
2	248.45	10	10	NS	NS
3	57.69	10	10	NS	NS
4	>0	10	10	NS	NS
5	19.2	10	10	NS	NS
<b>Total: 37,599.25</b>					

Notes:

NS = Not scored  
> = Greater than

Reference: 1, Section 2.4.2.1.5, Table 2-6

#### Other Potential Sources:

Several other potential sources exist at the SLC facility (Ref. 6, pp. 23 through 41). However, inadequate information is available to evaluate these other sources.

One of these other sources is underground storage tanks formerly used to store tritium-contaminated wastewater. Prior to 1972, tritium-contaminated wastewater previously was contained in below-ground tanks in a vault in the basement of the Liquid Waste Building (Refs. 4, p. 12.49; 6, p. 28). In 1972, the North Branch of the Susquehanna River flooded the building and a tank (Tank A) containing tritium-contaminated wastewater was uprooted from its location; the contents of Tank A dispersed in the flood water (Refs. 4, p. 12.49; 6, p. 28; 24). Before the flood, Tank A contained about 500 gallons of tritium-contaminated wastewater (Ref. 24). A sample of the flood water inside of the building contained  $0.07 \times 10^{-3} \mu\text{Ci/mL}$  of tritium (Ref. 24). The remaining tank was subsequently filled and the vault was capped. The remainder of the building was filled with soil and covered with a concrete slab. The concrete slab, which is the floor of the current building is cracked (Ref. 6, p. 28). No sampling data from the contents of the tank is available prior to the 1972 flood.

## GROUND WATER MIGRATION PATHWAY

### 3.0.1 General Considerations

Aquifer/Stratum Name: Hamilton Group Aquifer

Description: The SLC facility is located in the Appalachian Mountain Section of the Valley and Ridge Physiographic region of Columbia County, Pennsylvania (Ref. 9, p. 3-2). The topography of the region is characterized by a series of ridges and valleys that are controlled by the structure and weathering characteristics of the different lithologies (Ref. 30, p. 192). Generally, the ridges are underlain by resistant sandstones, cherty limestones, and cherty dolomites; the valleys are generally underlain by less resistant shale, limestone, and dolomite (Ref. 30, p. 192). The ridges are only slightly dissected by drainages, and the majority of streams and smaller tributaries flow along the valley floors (Ref. 9, p. 3-2). The North Branch of the Susquehanna River flows in a westerly direction through the region, and the facility is located on a middle terrace of the river (Refs. 3; 9, p. 3-2). The river forms the southern boundary of the SLC facility (Ref. 13, p. 1).

Regional structure consists of broadly folded rocks (Ref. 31, p. 23). The rocks have been folded into a series of anticlines and synclines (Ref. 9, p. 3-2). The facility is located on the southern limb of the Berwick anticline, which trends in a northeasterly direction (Ref. 9, p. 3-2). Topographic elevations in the region range from 200 to 500 feet above mean sea level (msl), with topographic relief generally less than 200 feet (Ref. 30, p. 192). Topographic elevations in the vicinity of the facility range from 460 to 495 feet above msl (Ref. 3).

Stratigraphy in the area consists of a generally thin, unconsolidated surficial sequence which is underlain by 16 distinct bedrock formations (Ref. 32, p. 7). River valleys in the regions typically are covered with relatively coarse-grained, unconsolidated glacial outwash deposits (Ref. 9, p. 3-2). These deposits range from about 35 to 45 feet thick at the SLC facility and consist primarily of sand and gravel (Ref. 18, p. 32). The unconsolidated deposits observed at the facility can be subdivided into two units: a surficial, coarse sand and gravel with large sandstone boulders, which overlies a sand and gravel unit lying directly above the bedrock (Ref. 18, p. 32). The surficial unit is generally 15 to 25 feet thick, and the deeper unit is about 10 to 20 feet thick (Ref. 18, p. 20). On the southern side of the SLC facility at the bank of the Susquehanna River, flood plain deposits of silt and sandy silt are present in place of the surficial sand and gravel (Ref. 18, p. 32, Figure 1). Regionally, thinner deposits of generally finer-grained and more poorly sorted clay, silt, sand, and gravel mixtures occur in the upland areas (Ref. 18, pp. 42-70).

Bedrock units directly beneath the facility consist of the Middle and Lower Devonian-aged Hamilton Group, Onondaga Formation, Old Port Formation, and Upper Keyser Formation (Ref. 33, Map 1, Plate 2). At the location of the facility, these units are about 2,100 feet thick, as measured perpendicular to bedding (Ref. 33, Map 1, Plate 2). Beneath the facility, the units dip to the southwest at about 45 degrees, and extend to a depth of about 1,100 feet, as measured perpendicular to ground surface (Ref. 33, Map 1, Plate 2). The thickness of the individual units beneath the facility are not known. Because of the complex structure, the bedrock unit present at the surface varies considerably in the vicinity of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The surficial bedrock unit underneath the SLC facility is the Hamilton Group (Ref. 33, Map 1, Plate 1, East Half). The Hamilton Group is composed of the Mahantango Formation and the underlying Marcellus Formation (Ref. 33, Map 1, Plate 1, East Half). The Mahantango Formation consists of olive, fine- to coarse-grained sandstone, with gray to brown shale interbeds (Ref. 34, p. 171). The top of the formation generally occurs from 35 to 45 feet bgs at the SLC facility (Ref. 30, Figure 1). Borings installed at the

SLC facility appear to penetrate the Mahantango Formation at a maximum of about 6 inches (Ref. 13, Appendix B). Beneath the SLC facility, the Mahantango Formation has been eroded flat and bedding dips at an angle of 45 degrees (Ref. 13, p. 20). Regionally, the formation is 1,150 to 1,500 feet thick (Ref. 32, p. 26).

The Marcellus Formation underlies the Mahantango Formation and is a black, carbonaceous shale that may contain limestone beds and pyrite and siderite concentrations (Ref. 34, p. 174). Bedding is moderately well developed and fissile (Ref. 34, p. 174). Regionally, the Marcellus Formation is 300 to 350 feet thick (Ref. 32, p. 24).

The Onondaga Formation underlies the Mahantango Formation and is a medium-gray limestone, with interbedded calcareous shale and claystone, in the lower portions of the formation (Ref. 34, p. 212). Bedding is well developed and massive (Ref. 34, p. 212). Regionally, the formation is 50 to 175 feet thick (Ref. 32, p. 23). The nearest occurrence of the undivided Onondaga and Old Port Formations as the surficial bedrock unit is at a distance of about 0.36 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Old Port Formation underlies the Onondaga Formation and consists of sandstone, chert, shale, and limestone (Ref. 34, p. 203). The formation may be differentiated into five members, but is often mapped as a single unit, because individual members are often thin, locally absent, or poorly exposed (Ref. 34, p. 204). Regionally, the formation is 46 to 150 feet thick (Ref. 32, p. 21). The nearest occurrence of the undivided Onondaga and Old Port Formations, as the surficial bedrock unit, is at a distance of about 0.36 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Upper Keyser Formation underlies the Old Port Formation and consists of dolomite calcisiltite and interbedded, calcareous clay shale (Ref. 32, p. 19). The formation is laminated to thinly bedded (Ref. 32, p. 19). Regionally, the formation is up to 39 feet thick (Ref. 32, p. 19). The nearest occurrence of the Upper Keyser Formation, as the surficial bedrock unit, is at a distance of about 0.4 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

In descending stratigraphic order, the Silurian-aged Middle and Lower Keyser, Tonoloway, Willis Creek, Bloomsburg, and Mifflintown Formations underlie the Upper Keyser Formation. Each of these formations occurs as the surficial bedrock unit in the vicinity of the SLC facility (Ref. 33, Map 1, Plate 1, East Half). Directly under the SLC facility, the formations dip to the southwest at about 45 degrees (Ref. 33, Map 1, Plate 2). At the facility, these units, including the Clinton Group, which does not occur as the surficial unit in the vicinity of the facility, extend from a depth of about 1,100 to 4,600 feet (Ref. 33, Map 1, Plate 2). The combined thickness of the formations, measured perpendicular to bedding, is about 2,500 feet (Ref. 33, Map 1, Plate 2).

The Middle and Lower Keyser Formations underlie the Upper Keyser Formation and are composed of argillaceous calcisiltite and fine calcarenite and fossiliferous calcarenite with interbedded calcareous shale, respectively (Ref. 32, p. 19). The Middle and Lower Keyser Formations are about 90 feet thick (Ref. 32, p. 19). The formations have thick to thin bedding and wavy bedding partings (Ref. 32, p. 19). The nearest occurrence of the undivided Keyser and Tonoloway Formations, as the surficial bedrock unit, is at a distance of about 0.4 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Tonoloway Formation underlies the Keyser Formation, and is composed of gray, laminated limestone, containing interbedded zones of gray shale and siltstone (Ref. 34, p. 273). The formation contains thick, well developed beds (Ref. 34, p. 273). The formation is about 200 feet thick (Ref. 32, p. 17). The nearest occurrence of the undifferentiated Keyser and Tonoloway Formations, as the surficial bedrock unit, is at a distance of about 0.4 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Willis Creek Formation underlies the Tonoloway Formation and is composed of gray shale, containing local limestone and sandstone zones (Ref. 34, p. 286). Red shale and siltstone occur in the lower part of the formation (Ref. 34, p. 286). The formation is about 650 feet thick (Ref. 32, p. 15). The nearest occurrence of the Willis Creek Formation as the surficial bedrock unit is at a distance of about 0.6 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Bloomsburg Formation underlies the Willis Creek Formation and consists of red shale and siltstone, some sandstone, and some impure limestone and green shale (Ref. 34, p. 42). The formation is fissile to thin and moderately well bedded (Ref. 34, p. 42). The formation is about 500 feet thick (Ref. 32, p. 13). The nearest occurrence of the undivided Bloomsburg and Mifflintown Formations, as the surficial bedrock unit, is about 1 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Mifflintown Formation underlies the Bloomsburg Formation and consists of gray shale, interbedded with gray fossiliferous limestone and intraformational breccia in the lower part of the formation (Ref. 34, p. 187). The formation has fissile to thin, well developed beds (Ref. 34, p. 187). The formation is about 200 feet thick (Ref. 32, p. 12). The nearest occurrence of the undivided Bloomsburg and Mifflintown Formations, as the surficial bedrock unit, is about 1 mile northwest of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

In addition to the above units, which occur in descending stratigraphic sequence directly underneath the SLC facility and as the surficial bedrock units in the SLC facility vicinity, several younger units also occur as the surficial bedrock units surrounding the SLC facility (Ref. 33, Map 1, Plate 2). These formations, in stratigraphically ascending order, are the Upper Devonian-aged Catskill Formation, the Mississippian and Devonian-aged Spechty Kopf Formation, and Mississippian-aged Pocono and Mauch Chunk Formations (Ref. 33, Map 1, Plate 2).

The Catskill Formation overlies the Hamilton Group and consists of shale, siltstone, sandstone, and conglomerate (Ref. 34, p. 59). Bedding is generally well developed, and crossbedding is common (Ref. 34, p. 59). The formation is about 5,600 feet thick (Ref. 32, p. 31). The nearest occurrence of the Catskill Formation, as the surficial bedrock unit, is about 0.4 mile southeast of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Spechty Kopf Formation overlies the Catskill Formation and consists of fine- to medium-grained sandstone, containing interbeds of shale and siltstone (Ref. 34, p. 265). Bedding is well developed and contains some crossbeds (Ref. 34, p. 265). The formation is up to 575 feet thick (Ref. 34, p. 265). The nearest occurrence of the Spechty Kopf Formation, as the surficial bedrock unit, is about 3 miles southeast of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Pocono Formation overlies the Spechty Kopf Formation and consists of fine- to medium-grained, crossbedded sandstone, siltstone, and conglomerate (Ref. 34, p. 225). Bedding is well developed, and crossbedding is common (Ref. 34, p. 225). The formation is 600 to 650 feet thick (32, p. 40). The nearest occurrence of the Pocono Formation, as the surficial bedrock unit, is about 3.1 miles southeast of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

The Mauch Chunk Formation overlies the Pocono Formation and consists of shale, claystone, siltstone, and sandstone (Ref. 34, p. 177). The formation is moderately well bedded, and crossbedding is common in sandstone and siltstone (Ref. 34, p. 177). The formation is about 500 feet thick (Ref. 32, p. 41). The nearest occurrence of the Mauch Chunk Formation, as the surficial bedrock unit, is about 3.4 miles southeast of the SLC facility (Ref. 33, Map 1, Plate 1, East Half).

Ground water in the region occurs in both the unconsolidated overburden and in the bedrock. Precipitation infiltrates the soil and moves downward, until it reaches the water table (Ref. 31, p. 24). After reaching the water table, the water moves laterally toward lower hydraulic potential and eventually returns to land surface by way of springs or as base flow to streams or other surface water bodies (Ref. 31, p. 24). Most ground water flow occurs in isolated, shallow-flow systems, from ridge to valley (Ref. 30, p. 192). The water table in the region is a subdued replica of topography, at a higher altitude underneath hills and ridges and at a lower altitudes in valleys (Ref. 31, p. 24). The Susquehanna River, which is located on the southern boundary of the SLC facility, is the largest surface water body in the region (Ref. 31, p. 23). A number of minor streams are also present (Ref. 31, p. 23).

In wells installed at the facility, the water table ranges from 2 to 25 feet bgs (Ref. 31, Table 5). Ground water flow in the unconsolidated materials at the facility has been observed to generally be to the south, directly toward the Susquehanna River (Ref. 18, p. 37). Under these conditions, the gradient of the water table has been observed to increase nearer the river, as the water passes from the coarse-grained materials to the finer-grained flood plain sediments on the riverbank (Ref. 31, Table 6). It should be noted that flow also has been observed to be away from the river, but this condition is thought to be created by temporary, high-flow conditions in the river (Ref. 18, p. 37).

Estimates of hydraulic conductivity based on laboratory testing of the sand and gravel, range from 4.2 to 230 gallons per day per square feet (gpd/ft<sup>2</sup>) (Ref. 18, Table 4). Estimates of 100 gpd/ft<sup>2</sup> and higher are consistent with clean sands and gravels (Ref. 35, Table 2.2). Estimates lower than that are likely indicative of higher concentrations of finer-grained materials in the sand and gravel (Ref. 18, p. 34). Hydraulic conductivities of the finer-grained flood plain deposits would be expected to range from about 0.01 to 1 gpd/ft<sup>2</sup> (Ref. 35, Table 2.2).

No documentation of the interaction between ground water in unconsolidated materials at the SLC facility and the adjacent Susquehanna River was found; however, ground water in the region commonly returns to land surface as base flow to surface water bodies (Ref. 31, p. 24). Based on ground water flow directions observed, this would appear to be occurring at the facility.

The shale bedrock floor of the Mahantango Formation that underlies the facility acts as a boundary between the overlying unconsolidated sand and gravel and the bedrock aquifer systems (Ref. 18, p. 34). This shale bedrock is estimated to also extend beneath the Susquehanna River (Ref. 33, Map 1, Plate 1, East Half). The Susquehanna River apparently receives the ground water discharge from the facility (Ref. 18, p. 37). Hydraulic conductivities of shale typically range from 0.01 to 0.00001 gpd/ft<sup>2</sup> (Ref. 35, Table 2.2). Within the bedrock units, fine-grained formations typically act as aquitards, while coarse-grained formations and areas with significant dissolution features act as aquifers (Ref. 30, Table 1).

### 3.1 LIKELIHOOD OF RELEASE

#### 3.1.1 Observed Release

Aquifer Being Evaluated: Hamilton Group Aquifer

#### Chemical Analysis

- Background Samples, 2000 PADEP Ground Water Assessment

Background ground water sample SLC-GW-SL-15 was collected from SLC Monitoring Well SL-15 by PADEP on August 9, 2000 (Ref. 23, App. A, p. 23; 49, p. 11). Monitoring Well SL-15 is located in the north-central portion of the SLC facility, north of the on-site buildings (Ref. 23, p. 4).

<b>Sample Identification</b>	<b>Total Depth<sup>a</sup> (feet)</b>	<b>Depth to Water<sup>a</sup> (feet)</b>	<b>Date Sampled</b>	<b>Sampling Location</b>	<b>Reference</b>
SLC-GW-SL-15	36.12	25.29	8/9/00	North-central portion of the facility property, north of the on-site buildings and waste disposal areas	23, p. 4, App. A, p. 23; 49, p. 11

Notes:

- <sup>a</sup> = The total well depth and depth to ground water are measured from the top of the well casing.  
 SLC = Safety Light Corporation  
 GW = Ground water  
 SL = Safety Light monitoring well

- Background Sample Concentrations, 2000 PADEP Ground Water Assessment

Background ground water sample SLC-GW-SL-15 was used to establish background concentrations in the Hamilton Group Aquifer. The ground water sample was analyzed by Severn Trent Laboratory for inorganic constituents (filtered and unfiltered), organic compounds, and radionuclides (Ref. 23, p. 3). Sampling locations are shown in Figure 2 of the PADEP report (Ref. 23, p. 4).

### TAL Inorganic Constituents

The inorganic compounds listed in the table below represent unfiltered ground water samples collected by PADEP (Ref. 23, App. B, Table 3, p. 3). Analytical data sheets are provided in Appendix C of Reference 23. Appendix C is comprised of six lots or sets of analytical data that are individually numbered. Therefore, Appendix C was labeled as Appendices C1, C2, C3, C4, C5, and C6 to differentiate between the lots (Ref. 23, Appendix C). Data validation was conducted by EPA and is contained in Reference 52.

Sample Identification	Hazardous Substance	Concentration (µg/L)	Reporting Limit (µg/L)	References
SLC-GW-SL-15	Arsenic	1.4U	10	23, App. C1, p. 917, C6, p. 1627
	Lead	1.9U	3	
	Nickel	13.3U	40	

Notes:

GW = Ground water sample  
 SL = Safety Light monitoring well  
 SLC = Safety Light Corporation  
 U = Undetected; value is the minimum quantitation limit  
 µg/L = Micrograms per liter

## Radionuclide Activity

Ground water sample SLC-GW-LSL-15 was analyzed for gross alpha, gross beta, gamma scan, and several individual radionuclides (Ref. 23, p. App. B, Table 4, p. 5, Appendix C). Analytical data sheets for the radionuclide analyses are provided in Appendix C of Reference 23. Radium-228 is an isotope of radium-226 (Ref. 51, p. 307). Radium-226 is the only naturally occurring radionuclide used at SLC. Tritium and strontium-90 are not naturally occurring. (Ref. 11, p. 3). Baseline ground water samples for the period of August 2000 are not available; therefore, the designated background sample results and its uncertainty (reported as  $2\sigma$ ) were used to establish the observed release criteria (Ref. 23, App. B, Table 4, p. 5). The uncertainty of  $2\sigma$  was added to the sample concentration to calculate the observed release criteria (Ref. 23, App. C). Data validation was conducted by EPA and is contained in Reference 53.

Sample ID	Radionuclide	Activity (pCi/L)	$2\sigma$ Error (pCi/L)	Observed Release Criteria (pCi/L)	MDA (pCi/L)	References
SLC-GW-SL-15	Tritium	325	159	480	247	23, App. C1, pp. 507, 917, C2, p. 178, C4, p. 1366
	Radium-228	0.369	0.410	9.70	0.682	
	Strontium-90	1.03	0.826	1.856	1.32	

Notes:

GW = Ground water sample  
MDA = Minimum detected activity  
pCi/L = Picocuries per liter  
SL = Safety Light monitoring well  
SLC = Safety Light Corporation  
 $2\sigma$  = Two standard deviations

-Contaminated Samples, 2000 PADEP Ground Water Assessment

Ground water samples listed in the table below were collected by PADEP in August 2000 (Ref. 23, App. B). The monitoring well locations are depicted in Figure 2 of Reference 23.

Sample Identification	Total Depth <sup>a</sup> (feet)	Depth to Water <sup>a</sup> (feet)	Sample Date	Sampling Location	References
SLC-GW-CN-A	26.38	3.99	8/7/00	Southwest of SLC facility, on Vance-Walton property	23, p. 4, App. A, p. 1; 50, p. 4
SLC-GW-CN-B	31.74	11.63	8/8/00	Southwest of SLC facility, about 50 feet from house on Vance-Walton property	23, p. 4, App. A, p. 2; 50, p. 8
SLC-GW-CN-D	14.66	3.52	8/7/00	Southeastern portion of SLC facility, about 80 feet from the river	23, p. 4, App. A, p. 4; 50, p. 3
SLC-GW-CN-F	28.09	6.17	8/9/00	Southeastern portion of Vance-Walton property, in abandoned canal	23, p. 4, App. A, p. 6; 50, pp. 10, 11
SLC-GW-CN-G	19.96	8.05	8/7/00	Near southwestern corner of SLC property, about 75 feet from the river	23, p. 4, App. A, p. 7; 49, p. 6
SLC-GW-CN-H	21.75	11.50	8/8/00	Vance-Walton property, just north of the abandoned canal	23, p. 4, App. A, p. 8; 49, p. 9
SLC-GW-CN-I	26.57	16.29	8/8/00	Eastern portion of the SLC facility, near the fenceline and Vance-Walton property	23, p. 4, App. A, p. 9; 49, p. 9
SLC-GW-MS-01	20.78	14.38	8/9/00	SLC property, north of the Lacquer storage building	23, p. 4, App. A, p. 10; 49, p. 11
SLC-GW-MS-02	11.05	6.89	8/7/00	Southeastern corner of the SLC facility, south of the abandoned canal	23, p. 4, App. A, p. 11; 49, pp. 4, 9
SLC-GW-MS-03	10.00	4.59	8/8/00	Southwestern corner of SLC facility, south of the abandoned canal and lagoons	23, p. 4, App. A, p. 12; 49, p. 7
SLC-GW-MS-04	14.22	7.42	8/8/00	South of the east lagoon, about 120 feet from the river	23, p. 4, App. A, p. 13; 50, p. 5
SLC-GW-MS-05	13.22	6.28	8/7/00	South of the east lagoon, about 75 feet from the river	23, p. 4, App. A, p. 14; 50, p. 3
SLC-GW-MS-06	12.97	5.30	8/8/00	In abandoned canal, east of the discharge line from the main processing building	23, p. 4, App. A, p. 15; 49, p. 7

Sample Identification	Total Depth <sup>a</sup> (feet)	Depth to Water <sup>a</sup> (feet)	Sample Date	Sampling Location	References
SLC-GW-MS-07	21.94	15.2	8/9/00	Central portion of SLC facility, east of the Anodizing Building	23, p. 4, App. A, p. 16; 50, pp. 11, 12
SLC-GW-MS-08	16.62	12.16	8/8/00	Adjacent to the eastern side of the Lacquer Storage Building	23, p. 4, App. A, p. 17; 49, p. 8
SLC-GW-MS-09	18.77	12.51	8/8/00	Southwestern corner of the former location of the buried silos	23, p. 4, App. A, p. 18; 50, p. 7
SLC-GW-MS-09D	18.77	12.51	8/8/00	Southwestern corner of the former location of the buried silos	23, p. 4, App. A, p. 18; 50, p. 7
SLC-GW-MS-10	19.52	7.01	8/9/00	Southeastern corner of the former location of the buried silos	23, p. 4, App. A, p. 19; 50, p. 9
SLC-GW-MS-11	12.27	8.18	8/8/00	In abandoned canal, south of the Lacquer Storage Building	23, p. 4, App. A, p. 20; 50, pp. 6, 7
SLC-GW-MS-12	14.15	6.82	8/8/00	Central portion of the SLC facility, immediately south of the abandoned canal	23, p. 4, App. A, p. 21; 50, p. 6
SLC-GW-MS-13	21.48	15.19	8/9/00	West of the west lagoon, near the property line	23, p. 4, App. A, p. 22; 50, pp. 9, 10

Notes:

<sup>a</sup> = Total depths and depths to ground water are measured from the top of the well casing.

-- = Not recorded

CN = Chem-Nuclear monitoring well

GW = Ground water sample

MS = Monserco monitoring well

A - I = Alphabetical nomenclature of wells

09D = Duplicate sample of SLC-GW-MS-09

SLC = Safety Light Corporation

- Contaminated Sample Concentrations, 2000 PADEP Ground Water Assessment

Ground water samples listed in the table below document observed releases to the Hamilton Group Aquifer. The ground water samples were analyzed by Severn Trent Laboratory for inorganic constituents (filtered and unfiltered), organic compounds, and radionuclides (Ref. 23, p. 3). Sampling locations are shown in Figure 2 of the PADEP report (Ref. 23, p. 4).

**TAL Inorganic Constituents**

The inorganic compounds listed in the table below represent unfiltered ground water samples collected by PADEP (Ref. 23, App. B, Table 3, p. 3). The analytical data sheets are provided in Appendix C of Ref. 23. Data validation was conducted by EPA and is contained in Reference 52.

Sample Identification	Hazardous Substance	Concentration (µg/L)	Reporting Limit (µg/L)	Reference(s)
SLC-GW-CN-A	Lead	9.7	3	23, App. C4, pp. 130, 1465
SLC-GW-CN-D	Arsenic	24.8	10	23, App. C4, pp. 129, 1465
	Lead	44.9	3	
	Nickel	73.3	40	
SLC-GW-CN-G	Lead	3.8	3	23, App. C4, pp. 126, 1465
SLC-GW-CN-H	Arsenic	13.6	10	23, App. C5, pp. 333, 2189
	Lead	26.6	3	
SLC-GW-CN-I	Arsenic	42.3	10	23, App. C5, pp. 332, 2189
	Lead	66.6	3	
	Nickel	559	40	
SLC-GW-MS-01	Arsenic	17.2	10	23, App. C5, pp. 343, 2192
	Lead	41.8	3	
SLC-GW-MS-02	Lead	3.8	3	23, App. C5, pp. 330, 2189
SLC-GW-MS-03	Lead	3.3	3	23, App. C5, pp. 337, 2190
SLC-GW-MS-04	Arsenic	26.2	10	23, App. C5, pp. 336, 2190
	Lead	20.1	3	

Sample Identification	Hazardous Substance	Concentration (µg/L)	Reporting Limit (µg/L)	Reference(s)
SLC-GW-MS-05	Arsenic	211	10	23, App. C4, pp. 127, 128, 1465
	Lead	689	3	
	Nickel	494	200	
SLC-GW-MS-06	Arsenic	46.9	10	23, App. C5, pp. 339, 2190
	Lead	111	3	
	Nickel	129	40	
SLC-GW-MS-07	Arsenic	26.7	10	23, App. C1, p. 917, C6, p. 1626
	Lead	54.8	3	
	Nickel	55.7	40	
SLC-GW-MS-08	Arsenic	234	10	23, App. C5, pp. 340, 2190
	Lead	26.6	3	
SLC-GW-MS-10	Arsenic	55	10	23, App. C5, pp. 342, 2192
	Lead	182	3	
	Nickel	304	40	
SLC-GW-MS-11	Lead	14.2	3	23, App. C5, pp. 341, 2190
SLC-GW-MS-12	Arsenic	37.6	10	23, App. C5, pp. 338, 2190
	Lead	132	3	
	Nickel	203	40	
SLC-GW-MS-13	Arsenic	30.4	10	23, App. C5, pp. 344, 2192
	Lead	326	3	
	Nickel	373	40	

Notes:

CN = Chem-Nuclear Systems, Inc., monitoring well  
 GW = Ground water sample  
 µg/L = Micrograms per liter  
 MS = Monserco Limited monitoring well  
 SLC = Safety Light Corporation

## Radionuclide Activity

Ground water samples listed in the table below were analyzed for gross alpha, gross beta, gamma scan, and several individual radionuclides (Ref. 23, p. App. B, Table 4, p. 5, App. C). Analytical data sheets for the radionuclide analyses are provided in Appendix C of Reference 23. Radium-228 is an isotope of radium-226 (Ref. 51, p. 307). Radium-226 is the only naturally occurring radionuclide used at SLC. Tritium and strontium-90 are not naturally occurring. (Ref. 11, p. 3). The criteria of  $2\sigma$  above mean site-specific background concentrations for naturally occurring radionuclides was used to establish observed release for all radionuclides in the ground water observed release (Ref. 1, Section 7.1.1). All concentrations of strontium-90 and tritium for samples listed in the table below are above their respective minimum detected activity, which is the criteria for observed release in man-made radionuclides (Ref. 1, Section 7.1.1). However, the samples listed in the table below were compared to background ground water sample SLC-GW-SL-15 (Ref. 23, App. B, Table 4). In order to be conservative, the uncertainty reported was subtracted from the radionuclide concentration to get an adjusted radionuclide concentration. Data validation was conducted by EPA and is contained in Reference 53.

Sample ID	Radionuclide	Activity (pCi/L)	$2\sigma$ Error (pCi/L)	Adjusted Activity (pCi/L)	MDA (pCi/L)	Reference(s)
SLC-GW-CN-A	Tritium	1,980	262	1,718	79	23, App. C4, pp. 1369, 1465, C3, p. 543
	Strontium-90	21	4.44	16.56	1.63	
SLC-GW-CN-B	Tritium	2,060	267	1,793	1.98	23, App. C5, pp. 2068, 2189
SLC-GW-CN-D	Tritium	5,560	598	4,962	77.6	23, App. C3, pp. 119, 543, C4, pp. 1369, 1465
	Radium-228	38.9	4.19	34.71	1.16	
	Strontium-90	68.9	13.7	55.20	1.45	
SLC-GW-CN-F	Tritium	1,920	254	1,660	197	23, App. C5, pp. 2071, 2192
SLC-GW-CN-H	Tritium	2,720	327	2,393	195	23, App. C5, pp. 2068, 2189
SLC-GW-CN-I	Tritium	1,820	245	1,575	196	23, App. C5, pp. 2068, 2189
SLC-GW-MS-01	Tritium	4,290	475	3,815	197	23, App. C2, pp. 176, 625, C5, pp. 2071, 2192
	Radium-228	181	18.1	162.9	0.962	
	Strontium-90	345	68	227	1.46	

GW - Observed Release  
Hamilton Group Aquifers

Sample ID	Radionuclide	Activity (pCi/L)	2 $\sigma$ Error (pCi/L)	Adjusted Activity (pCi/L)	MDA (pCi/L)	Reference(s)
SLC-GW-MS-02	Tritium	9,050	936	8,114	197	23, App. C1, pp. 87, 917, C2, p. 625, C5, pp. 2068, 2189
	Radium-228	48.4	4.97	43.43	0.72	
	Strontium-90	87.6	17.3	70.3	0.565	
SLC-GW-MS-03	Tritium	5,790	619	5,171	196	23, App. C2, p. 625, C5, pp. 2068, 2190
	Strontium-90	44.5	8.81	35.69	0.662	
SLC-GW-MS-04	Tritium	3,780	426	3,354	195	23, App. C2, pp. 176, 625, C5, pp. 2068, 2190
	Radium-228	615	61.5	553.5	2.69	
	Strontium-90	6,450	1,270	5,180	8.02	
SLC-GW-MS-05	Tritium	2,860	341	2,519	77.6	23, App. C3, pp. 119, 543, C4, pp. 1369, 1465
	Radium-228	95.5	9.72	85.78	1.18	
	Strontium-90	159	31.4	127.6	1.48	
SLC-GW-MS-06	Tritium	4,210	467	3,743	194	23, App. C2, pp. 176, 625, C5, pp. 2068, 2190
	Radium-228	44.2	4.65	39.55	1.04	
	Strontium-90	140	27.6	112.4	0.878	
SLC-GW-MS-07	Strontium-90	35.5	7.3	28.2	2.0	23, App. C1, pp. 507, 917
SLC-GW-MS-08	Tritium	5,700	610	5,090	197	23, App. C2, pp. 176, 625, C5, pp. 2071, 2190
	Radium-228	237	23.7	213.3	1.33	
	Strontium-90	696	137	559	2.77	
SLC-GW-MS-09	Tritium	3,600	409	3191	196	23, App. C2, pp. 178, 625, C5, pp. 2068, 2189
	Radium-228	3,950	395	3,555	4.87	
	Strontium-90	10,000	1,970	8,030	9.06	
SLC-GD-MS-09	Tritium	3,830	431	3,399	196	23, App. C2, pp. 176, 625, C5, pp. 2068, 2189
	Radium-228	4,710	471	4,239	6.09	
	Strontium -90	9,410	1,850	7,560	8.76	

GW - Observed Release  
Hamilton Group Aquifers

Sample ID	Radionuclide	Activity (pCi/L)	2 $\sigma$ Error (pCi/L)	Adjusted Activity (pCi/L)	MDA (pCi/L)	Reference(s)
SLC-GW-MS-10	Tritium	2,940	348	2,592	198	23, App. C2, pp. 176, 625, C5, pp. 2071, 2192
	Radium-228	11,400	1,140	10,260	9.63	
	Strontium-90	29,500	5,810	23,690	21	
LC-GW-MS-11	Radium-228	439	43.9	395.1	1.44	23, App. C2, pp. 176, 625, C5, pp. 2071, 2190
	Tritium	1,510	218	1,292	197	
	Strontium-90	1,110	220	890	2.98	
SLC-GW-MS-12	Tritium	1,830	245	1,585	194	23, App. C2, pp. 176, 625, C5, pp. 2068, 2190
	Radium-228	204	20.4	183.6	1.34	
	Strontium-90	351	69.1	281.9	1.43	
SLC-GW-MS-13	Tritium	2,960	349	2,611	197	23, App. C2, p. 625, C5, pp. 2071, 2192
	Strontium-90	10.6	2.23	8.37	0.817	

Notes:

CN = Chem-Nuclear System, Inc. well  
 GW = Ground water sample  
 GD = Duplicate ground water sample  
 ID = Identification number  
 MDA = Minimum detected activity  
 MS = Monserco Limited well  
 pCi/L = Picocuries per liter  
 SLC = Safety Light Corporation  
 2 $\sigma$  = Two standard deviations

- Background Sample, 1994 EPA Ground Water Sampling

Background ground water sample RW-3 was collected on March 29, 1994 by EPA. The sample was collected from a private well located within 0.25 mile east of the SLC facility (Ref. 41, p. 14). At the time of sampling, the total depth of the well was not known. In January 1994 the depth to ground water in the well was reported at 12 feet bgs (Ref. 41, pp. 21, 22). The topographic elevation in the vicinity of background ground sample RW-3 is about 480 feet above msl (Ref. 3).

Sample Identification	Date Sampled	Sampling Location	References
RW-3	3/29/94	Private well located about 0.43 mile east of the SLC facility	41, pp. 8, 14, 21, 23

Note:

RW = Residential well  
SLC = Safety Light Corporation

- Background Concentrations, 1994 EPA Ground Water Sampling

Ground water sample RW-3 was collected by EPA (Ref. 41, p. 14). The sample was analyzed by CompuChem Environmental Corporation (Ref. 41, p. 14). Data Validation was conducted by EPA Central Regional Laboratory (Ref. 42). The analytical data results for tritium analysis are contained on page 10 of Reference 41. Baseline ground water samples for the period of March 1994 are not available; therefore, a background sample was selected and its results and uncertainty (reported as  $2\sigma$ ) were used to establish the observed release criteria (Ref. 41, p. 10). The uncertainty of  $2\sigma$  was added to the sample concentration to calculate the observed release criteria (Ref. 41, p. 10).

Sample ID	Radionuclide	Activity (pCi/L)	$2\sigma$ Uncertainty (pCi/L)	Observed Release Criteria (pCi/L)	Contract Required Detection Limit	References
RW-3	Tritium	673	252	925	1,000	41, p. 10; 42, Table 1, p. 1

Notes:

ID = Identification  
pCi/L = Picocuries per liter  
RW = Residential well  
 $2\sigma$  = Two standard deviations

- Contaminated Samples, 1994 EPA Ground Water Sampling

Ground water samples RW-2, RW-4, RW-5, and RW-6 were collected from residential wells located in the vicinity of the SLC facility (Ref. 41, p. 8). The ground water samples from the residential wells were collected on March 29, 1994 by EPA (Ref. 41, p. 14). The topographic elevation in the vicinity of the residential wells sampled is about 480 feet above msl (Ref. 3).

Sample Identification	Well Depth	Depth to Water	Date Sampled	Sampling Location	Reference
RW-2	16 feet	3 feet	3/39/94	Private well on Old Berwick Road, west of the SLC facility	41, pp. 8, 14, 16, 18
RW-4	20 to 25 feet	~ 10 feet	3/39/94	Private well on Old Berwick Road, east of the SLC facility	41, pp. 8, 14, 25, 27
RW-5	20 to 25 feet	~ 10 feet	3/39/94	Private well on Old Berwick Road, east of the SLC facility	41, pp. 8, 14, 29, 31
RW-6	35 feet	8 feet	3/29/94	Private well on Old Berwick Road, east of the SLC facility	41, pp. 8, 14, 33, 35

Notes:

~ = Approximately  
RW = Residential well  
SLC = Safety Light Coropration

- Contaminated Concentrations, 1994 EPA Ground Water Sampling

The ground water samples listed in the table below were collected by EPA (Ref. 41, pp. 14, 15). The samples were analyzed by CompuChem Environmental Corporation under the Contract Laboratory Program (Refs. 41, p. 14, 15; 42). The analytical data sheets for tritium analysis are contained on page 10 through 13 of Reference 41. Data validation was performed by EPA Region 3, Central Regional Laboratory (Ref. 42). The concentrations in the samples listed in the table below were compared to background ground water sample RW-3 collected from a private well located about 0.43 mile east of the SLC facility (Ref. 41, p. 8). All concentrations of tritium for samples listed in the table below are above the contract required detection limit, which is the criteria for observed release in man-made radionuclides (Ref. 1, Section 7.1.1). In order to be conservative, the uncertainty reported was subtracted from the radionuclide concentration in each sample to get an adjusted radionuclide concentration (Ref. 41, pp. 10 through 13).

<b>Sample ID</b>	<b>Radionuclide</b>	<b>Activity (pCi/L)</b>	<b>2 <math>\sigma</math> Uncertainty (pCi/L)</b>	<b>Adjusted Activity (pCi/L)</b>	<b>Contract Required Detection Limit</b>	<b>References</b>
RW-2	Tritium	2,015	291	1,724	1,000	41, p. 10; 42, Table 1, p. 1
RW-4	Tritium	2,670	299	2,371	1,000	41, p. 10; 42, Table 1, p. 1
RW-5	Tritium	1,595	274	1,321	1,000	41, p. 10; 42, Table 1, p. 1
RW-6	Tritium	1,770	276	1,494	1,000	41, p. 11; 42, Table 1, p. 1

Notes:

pCi/L = Picocuries per liter  
 RW = Residential well  
 2 $\sigma$  = Two standard deviations

- Level I Samples

Samples: RW-2, RW-4, RW-5, RW-6.

Reference for Benchmarks: 2, p. B11-28

<b>Well Identification</b>	<b>Hazardous Substance</b>	<b>Hazardous Substance Concentration pCi/L</b>	<b>Uncertainty pCi/L</b>	<b>Benchmark Concentration pCi/L</b>	<b>Benchmark</b>	<b>Refs.</b>
RW-2 Old Berwick Road	Tritium	2,015	291	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8, 10
RW-4 Old Berwick Road	Tritium	2,670	299	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8, 10
RW-5 Old Berwick Road	Tritium	1,595	274	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8, 10
RW-6 Old Berwick Road	Tritium	1,770	276	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8, 11

Notes:

pCi/L = picocuries per liter

RW = Residential well

Residential drinking water wells listed in the table above were sampled by EPA in 1994 (Ref. 41, pp. 2, 14). Drinking water wells RW-4, RW-5, and RW-6 are located within 0.25 mile east of the SLC facility, and RW-2 is located within 0.25 mile west of the SLC facility (Ref. 41, p. 8). The samples were analyzed under the Contract Laboratory Program. Data validation was conducted by EPA Region 3, Central Regional Laboratory (Ref. 42). Based on the current service area of United Water Pennsylvania and information obtained from the PADEP, these residences currently rely on private wells for their potable water supply (Refs. 60; 61).

Attribution:

During World War II, the SLC facility was a wooden toy factory (Refs. 7, p. 1; 8, p. 1). After World War II, USRC purchased the facility and converted it into a radium and radioisotope processing facility (Refs. 7, p. 1; 8, p. 1). Operations at the SLC facility have taken place at this location since the late 1940s (Ref. 9, Section 5).

Early activities at SLC involved production of glow-in-the-dark markers for hatch openings in naval vessels (Ref. 37, p. 1). These signs were made with strontium-90 mixed with zinc sulphide phosphor (Ref. 14, p. 2). During the 1950s and 1960s, operations at the USRC facility included the use of americium-241, cobalt-60, iron-55, carbon-14, radium-226, strontium-90, promethium-147, thallium-204, nickel-63, cesium-137, neptunium-237, polonium-210, uranium-238, and krypton-85 (Refs. 7, p. 2; 8, p. 1; 9, Section 5; 10, p. 2; 13, p. 2). Presently, SLC manufactures exit signs, dials, paints, gas chromatograph foils, and accelerator targets that are illuminated with tritium (Refs. 6, pp. 3, 4; 10, p. 2; 37, p. 1). Low-level radioactive waste such as tritium is disposed of by shallow burial on land (Ref. 51, p. 311).

Wastes from facility operations were buried on the property and included radium-226, cesium-137, and strontium-90 (Ref. 10, p. 2). Contaminated laboratory glassware was also buried on the property (Ref. 14, p. 3). Contaminated solids were placed inside of two silos buried in the ground, which were 12 feet deep by 10 feet wide (Ref. 12, p. 2). Concentrated liquid wastes were allowed to evaporate, and the dry residuals were transferred to the Radiological Services Company (Ref. 7, p. 3). Additionally, plant effluent was discharged into the abandoned canal, located adjacent to the North Branch of the Susquehanna River (Ref. 15, p. 7). The canal was a series of about five individual impoundments, which were all part of the former river bed (Ref. 15, pp. 1, 2, 4, 7). These impoundments were filled with river water, allowing the wastes in them to be diluted prior to discharge into the North Branch of the Susquehanna River (Ref. 15, pp. 2, 5).

Available file information indicates that radioactive wastes also were disposed of in dry wells (Ref. 8, p. 1). Analyses of samples collected from the east lagoon indicated the presence of inorganic constituents and radionuclides including tritium, americium-241, strontium-90, cesium-137, and radium-226 (Refs. 10, p. 13; 28, p. 19; 36, pp. 7, 8). During the 1981 NRC investigation, surface and subsurface soil samples collected from the SLC facility contained radionuclides including radium-226, cesium-137, tritium, and strontium-90 (Ref. 10, pp. 14, 43, 44 through 47). The NRC investigation concluded that soil and water contamination are present in areas previously used for waste disposal activities and are evidence of radionuclide migration from the SLC facility (Ref. 10, p. 16).

During the 1979 SLC hydrogeologic investigation, two test pits were dug with a backhoe in the vicinity of the former canal (Ref. 18, pp. 32, 33). While these pits were being dug, water was encountered at a depth of about 5 feet bgs (Ref. 18, p. 33). Old fill material from the backfilled canals was encountered within the ground water, including wood, oil, and radioactive materials (Ref. 18, pp. 32, 33). Ground water samples collected from on-site monitoring wells contained radioactive hazardous substances, including cesium-137, strontium-90, and radium-226 (Ref. 18).

Analyses of ground water samples collected by the NRC in 1981 from on-site monitoring wells revealed tritium above the baseline water samples. Monitoring Well 21 contained the highest concentration of tritium at  $7.22 \times 10^{-5}$  microcuries per milliliter ( $\mu\text{Ci/ml}$ ) (Ref. 10, p. 13). Monitoring Wells 1, 3, and 4 contained strontium-90 at concentrations of  $6.21 \times 10^{-5}$ ,  $2.13 \times 10^{-6}$ , and  $4.77 \times 10^{-7}$   $\mu\text{Ci/ml}$ , respectively; these concentrations were higher than the NRC guideline level of  $3 \times 10^{-7}$   $\mu\text{Ci/ml}$  of strontium-90 in unrestricted areas (Ref. 10, p. 14).

Analyses of ground water samples collected during the 1990 SLC investigation showed an increase in tritium concentrations throughout the SLC facility, particularly in the southeastern portion (Ref. 13, pp. 17, 18, 24, Table 3). In 1994, EPA collected ground water samples from on-site monitoring wells and nearby residential wells. Analyses of the ground water samples collected from the residential wells indicated elevated concentrations of tritium ranging from 1,770 pCi/L to 2,670 pCi/L (Ref. 41, pp. 10, 11).

Analyses of the ground water samples collected from the monitoring wells revealed the presence of tritium at concentrations ranging from 1,898 to 5,727 pCi/L (Ref. 41, pp. 11, 12). These concentrations are above the EPA Superfund Chemical Data Matrix (SCDM) cancer risk concentration of 660 pCi/L (Ref. 2, p. BII-28). In 2000, PADEP collected ground water samples from on-site monitoring wells (Ref. 23, Figure 2, Appendices B and C). Radium-228 was detected in the on-site monitoring wells at elevated concentrations ranging from 44.2 pCi/L to 11,400 pCi/L. Strontium-90 was detected in the on-site monitoring wells at elevated concentrations ranging from 10.6 pCi/L to 29,500 pCi/L. Tritium was detected in the on-site monitoring wells at elevated concentrations ranging from 1,820 pCi/L to 9,050 pCi/L (Ref. 23, Appendices B and C).

Multi-Metals is collocated with SLC and conducts metal plating operations at the facility. PADEP personnel indicated that Multi-Metals and SLC operate under the same management structure. Multi-Metals manufactures watch dials and enclosures for SLC (Ref. 11). Wastes generated from the plating operations include toluene and xylene; and are stored on-site prior to disposal at an offsite facility. In 2000, PADEP conducted an inspection of Multi-Metals (SLC) and found several containers of waste including paint filters that were being stored on site for more than 90 days (Ref. 21, pp. 1, 2). A notice of violation subsequently was issued to SLC for the unauthorized storage of hazardous substances (Ref. 21, pp. 1, 2, 3).

During the 2000 PADEP ground water investigation, ground water samples were collected from on-site monitoring wells and two nearby residential wells (Refs. 23, Figure 2, Appendix A; 49; 50). One of the residential wells contained lead at 5.5 µg/L. The monitoring wells contained elevated concentrations of arsenic, lead, nickel, radium-228, strontium-90, and tritium (Ref. 23, Appendices B and C). In 2000, a sample collected from the silos prior to excavation failed the Toxicity Characteristics Leachate Procedure for barium, cadmium, copper, lead, mercury, zinc, and chlorobenzene (Ref. 20, pp. 10, 43, 69, 79, 71, 77). In 2002, PADEP collected a soil sample from a "hot spot" located south of the former location of the excavated silos (Ref. 57, pp. 2, 4, 8). Analyses of the soil sample contained the following radionuclides: radium -226 (25,013,482 pCi/Kg), strontium-90 (12,003 pCi/Kg), radium-228 (12,308 pCi/Kg), cesium-137 (653 pCi/Kg), and tritium (6,216 pCi/Kg) (Ref. 57, pp. 5, 9, A15).

Hazardous Substances Released:

Radium-228	Strontium-90
Tritium	Arsenic
Lead	Nickel

Ground Water Observed Release Factor Value: 550

### 3.2 WASTE CHARACTERISTICS

#### 3.2.1 Toxicity/Mobility

Hazardous Substance	Source Number	Toxicity Factor Value	Mobility Factor Value <sup>a</sup>	Toxicity/Mobility Value	Reference
Antimony	2	10,000	0.01	100	2, p. BI-1
Arsenic	1	10,000	1 <sup>b</sup>	10,000	2, p. BI-1
Cadmium	1, 2, 3, 4	10,000	0.01	100	2, p. BI-2
Chromium	1, 2, 3, 4	10,000	0.01	100	2, p. BI-3
Copper	1, 2, 3, 4	<sup>c</sup>	0.01	<sup>c</sup>	2, p. BI-3
Cyanide	2, 4	100	1	100	2, p. BI-4
Lead	1, 2, 3, 4	10,000	1 <sup>b</sup>	10,000	2, p. BI-8
Mercury	1, 2, 3, 4	10,000	0.01	100	2, p. BI-8
Nickel	2, 3, 4	10,000	1 <sup>b</sup>	10,000	2, p. BI-9
Selenium	1, 2, 3, 4	100	1	100	2, p. BI-10
Silver	1, 2, 3, 4	100	1	100	2, p. BI-10
Zinc	1, 2, 4	10	0.01	0.1	2, p. BI-12
Chlorobenzene	1	100	1	100	2, p. BI-3
Bismuth-214	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Cesium-137	1, 4	10,000	0.01	100	2, p. BI-13
Francium-223	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Lead-210	1	10,000	0.01	100	2, p. BI-13
Lead-214	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Potassium-40	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Protactinium-231	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Radium-223	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Radium-224	1	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	
Radium-226	1, 2, 4	10,000	0.01	100	2, p. BI-14
Radium-228	1, 2, 4	10,000	1 <sup>b</sup>	20	2, p. BI-14
Strontium-90	3, 4	10,000	1 <sup>b</sup>	10,000	2, p. BI-14
Thorium-231	1	1,000	0.01	10	2, p. BI-15
Thorium-234	1	10,000	0.01	100	2, p. BI-15
Tritium	1, 2, 3, 4, 5	100	1 <sup>b</sup>	100	2, p. BI-15
Uranium-235	1	10,000	0.2	2,000	2, p. BI-15

Notes:

- <sup>a</sup> - Mobility values for non-liquid waste, non-karst aquifers were used.
- <sup>b</sup> - An observed release was documented; therefore, a mobility value of 1 was assigned (Ref. 1, p. 51601).
- <sup>c</sup> - No toxicity value in the Superfund Chemical Data Matrix (SCDM)
- <sup>d</sup> - Radionuclide is not in the SCDM

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Toxicity/Mobility Factor Value: 10,000  
Reference: 1, Section 3.2.1.3, Table 3-9

**3.2.2 Hazardous Waste Quantity**

<b>Source Number</b>	<b>Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)</b>	<b>Are source hazardous constituent quantity data complete? (yes/no)</b>
1	37,273.91	No
2	248.45	No
3	57.69	No
4	>0	No
5	19.2	No
<b>Sum of Values: 37,599.25</b>		

The hazardous waste quantity is based on an estimated activity content of 186.23 curies of radionuclides in the silos, Source No. 1 (Refs. 1, Section 7.2.5.1.1; 26). The curies of radionuclides was converted to the equivalent lbs of non-radioactive hazardous substances by multiplying by 1,000; 186.23 curies x 1,000 = 186,230 lb (Refs. 1, Section 7.2.5.1.1, Table 2-5; 26). The average or mean constituent waste quantity using 5 samples collected from the silos was calculated as follows: 186,230 lb ÷ 5 = 37,246 lb (Ref. 26). The constituent quantity for Source No. 1 was added to the source hazardous waste quantities for Source Nos. 2 through 5 resulting in a sum of values of 37,978.58. This information applied to Table 2-6 of Reference 1, yields a hazardous waste quantity of 10,000 for the SLC.

Hazardous Waste Quantity Factor Value: 10,000  
(Ref. 1, Section 2.4.2.2, Table 2-6)

**3.2.3 Waste Characteristics Factor Category Value**

Toxicity/Mobility Factor Value: 10,000

Hazardous Waste Quantity Factor Value: 10,000  
(Ref. 1, Section 2.4.2.2, Table 2-6)

Toxicity/Mobility Factor Value (10,000)  
x Hazardous Waste Quantity Factor Value (10,000): 100,000,000

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Waste Characteristics Factor Category Value: 100  
(Ref. 1, Section 2.4.3.1, Table 2-7)

### 3.3 TARGETS

The following drinking water wells located within 4 miles of the facility were evaluated based on Level I and potential contamination.

Fifteen community, nine nontransient noncommunity, and four private drinking water wells are located within 4 miles of the SLC facility (Refs. 38; 39; 60; 61). The nearest private drinking water well is located within 0.25 mile west of the SLC facility (Refs. 3; 23; 41). The nearest community drinking water well is located about 1.2 miles northeast of the SLC facility (Ref. 38).

These twenty-eight drinking water wells serve about 3,287 people (Refs. 3; 38; 40; 41, p. 8). The estimated drinking water population is distributed as follows: 0 to 0.25 mile (10 persons); 0.25 to 0.50 mile (0 persons); 0.50 to 1 mile (0 persons); 1 to 2 miles (1,687 persons); 2 to 3 miles (1,687 persons); and 3 to 4 miles (428 persons) (Refs. 3; 38; 40; 41). (See section 3.3.2.4 of this documentation record for calculations.)

**Private, Community, and Non-transient Non-Community Drinking Water Wells within 4 Miles of the SLC facility**

<b>Well ID</b>	<b>Distance from Source (miles)</b>	<b>Depth (feet)</b>	<b>Number of Persons Served</b>	<b>Level I Contam. (Y/N)</b>	<b>Level II Contam. (Y/N)</b>	<b>Potential Contam.</b>	<b>Reference(s)</b>
RW-2	0.25	16	2.42	Y	N	N	40; 41
RW-4	0.25	20 - 25	2.42	Y	N	N	40; 41
RW-5	0.25	20 - 25	2.42	Y	N	N	40; 41
RW-6	0.25	35	2.42	Y	N	N	40; 41
Columbia Montour Area VO Tech	1.2	140	741	N	N	Y	38, p. 3; 39, p. 2; 59, pp. 2, 6
Saw Mill Road Office Building	1.6	NA	50	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 3, 7
HJ Heinz LP Well 2	1.6	550	750	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 2, 7
HJ Heinz LP Well 3	1.6	500	187.5	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 2, 7
HJ Heinz LP Well 5	1.6	570	187.5	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 2, 7
HJ Heinz LP Well 6	1.6	450	187.5	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 2, 7
Kleerdex	1.8	350	85	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 2, 7
Country Terrace Estates	1.9	350	61	N	N	Y	38, p. 2; 39, p. 1; 59, pp. 3, 6
Bloomsburg Christian School	2.0	503	80	N	N	Y	38, p. 3; 39, p. 2; 59, pp. 2, 7
PPL Electric Utilities Corp.	2.1	200	45	N	N	Y	38, p. 4; 39, p. 2; 59, pp. 3, 8
Balanced Care at Bloomsburg II	2.5	323	60	N	N	Y	38, p. 2; 39, p. 1; 59, pp. 2, 6
Pleasant View Estates Well 2	2.5	200	130	N	N	Y	38, 3; 39, p. 1; 59, pp. 2, 6
Brookside Village MHP Well 1	2.6	173	158	N	N	Y	38, p. 2; 39, p. 1; 59, pp. 2, 6
Brookside Village MHP Well 2	2.6	248	158	N	N	Y	38, p. 2; 39, p. 1; 59, pp. 2, 6

<b>Well ID</b>	<b>Distance from Source (miles)</b>	<b>Depth (feet)</b>	<b>Number of Persons Served</b>	<b>Level I Contam. (Y/N)</b>	<b>Level II Contam. (Y/N)</b>	<b>Potential Contam.</b>	<b>Reference(s)</b>
Brookside Village MHP Well 3	2.6	223	158	N	N	Y	38, p. 2; 39, p. 1; 59, pp. 2, 6
Pleasant View Estates Well 1	2.6	167	130	N	N	Y	38, p. 3; 39, p. 1; 59, pp. 2, 6
Pleasant View Estates Well 3	2.6	175	130	N	N	Y	38, p. 3; 39, p. 1; 59, pp. 2, 6
United Water PA Columbia Co. Industrial Park McGregor Well 1	2.9	NA	28	N	N	Y	38, p. 3; 39; 59, pp. 2, 7
United Water PA Columbia Co. Industrial Park McGregor Well 2	2.9	NA	28	N	N	Y	38, p. 3; 39; 59, pp. 2, 7
United Water PA Columbia Co. Industrial Park Scenic Knolls Well 1	2.9	NA	28	N	N	Y	38, p. 3; 39; 59, pp. 2, 7
United Water PA Columbia Co. Industrial Park Scenic Knolls Well 2	2.9	NA	28	N	N	Y	38, p. 3; 39; 59, pp. 2, 7
United Water PA Columbia Co. Industrial Park Scenic Knolls Well 3	3.1	NA	28	N	N	Y	38, p. 3; 39; 59; 59, pp. 2, 7
Stony Brook Circle MHP Well 1	3.3	387	200	N	N	Y	38, p. 3; 39, p. 1; 59, pp. 2, 6
Stony Brook Circle MHP Well 3	3.3	512	200	N	N	Y	38, p. 3; 39, p. 1; 59, pp. 2, 6

Notes:

Co. - County

ID - Identification  
MHP - Mobile Home Park  
N - No  
NA - Not available  
PA - Pennsylvania  
PPL - Pennsylvania Power and Light  
RW - Residential well  
Tech - Technical school  
VO - Vocational  
Y - Yes

**3.3.1 Nearest Well**

Wells: RW-2, RW-4, RW-5, RW-6

Level of Contamination: Level I

These 4 wells have Level I actual contamination. Therefore, the nearest well factor value is 50 (Refs. 1, Sections 3.3.1, and 7.3.2; 2, p. B-90; 41, pp. 2, 10, 11, 14).

Nearest Well Factor Value: 50

**3.3.2 Population****3.3.2.1 Level of Contamination**

- Level I Samples

Sample ID: RW-2, RW-4, RW-5, RW-6

Reference for Benchmarks: 2, p. BII-28

<b>Well Identification</b>	<b>Hazardous Substance</b>	<b>Hazardous Substance Concentration (pCi/L)</b>	<b>Uncertainty (pCi/L)</b>	<b>Benchmark Concentration (pCi/L)</b>	<b>Benchmark</b>	<b>Refs.</b>
RW-2 Old Berwick Road	Tritium	2,015	291	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8
RW-4 Old Berwick Road	Tritium	2,670	299	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8
RW-5 Old Berwick Road	Tritium	1,595	274	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8
RW-6 Old Berwick Road	Tritium	1,770	276	430	Cancer risk	2, p. BII-28; 41, pp. 7, 8

Notes:

pCi/L = picocuries per liter

RW = Residential well

Refs. = References

Residential wells in the immediate vicinity of the SLC facility were sampled in 1994 by EPA (Ref. 41, pp. 2, 14). The exact population of each residence at the time of sampling is not known. These residences are not served by municipal water; therefore, the U.S. Bureau of the Census, 2000 Census of Population average household size of 2.42 for Columbia County, Pennsylvania, was used for the population (Refs. 40; 60; 61).

### 3.3.2.2 Level I Concentrations

Level I Well	Population	Reference(s)
RW-2	2.42	40
RW-4	2.42	40
RW-5	2.42	40
RW-6	2.42	40

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Population Served by Level I Wells: 9.68  
 Level I Concentrations Factor Value: 96.8  
 Reference: 1, Section 3.3.2.2

### 3.3.2.3 Level II Concentrations

No Level II concentrations were evaluated.

**3.3.2.4 Potential Contamination - Hamilton Group Aquifer**

Distance-weighted population values were determined for nonkarst conditions. (See Section 3.0.1 of this Documentation Record.) The calculations used to determine the potentially affected ground water population are presented below.

<b>Distance from Source</b>	<b>Number of Wells x Persons per Well</b>	<b>Number of Persons Served</b>	<b>Refs.</b>
1 to 2 miles	Columbia Montour Area Vo. Tech (1 well) x 741 persons per well	741	38, p. 3
1 to 2 miles	Saw Mill Rd. Office Bld. (1 well) x 50 persons per well	50	38, p. 4
1 to 2 miles	HJ Heinz LP (4 wells) x 187.5 persons per well	750	38, p. 4
1 to 2 miles	Kleerdex (1 well) x 85 persons per well	85	38, p. 4
1 to 2 miles	Country Terrace Estates (1 well) x 61 persons per well	61	38, p. 2
2 to 3 miles	Bloomsburg Christian School (1 well) x 80 persons per well	80	38, p. 3
2 to 3 miles	PPL Electric Utilities Corp. (1 well) x 45 persons per well	45	38, p. 4
2 to 3 miles	Balanced Care at Bloomsburg II (1 well) x 60 persons per well	60	38, p. 2
2 to 3 miles	Pleasant View Estates (3 wells) x 130 persons per well	390	38, p. 3
2 to 3 miles	Brookside Village MHP (3 Wells) x 158.3 persons per well	475	38, p. 2
2 to 3 miles	United Water PA Columbia Co. Industrial Park (4 wells) x 28 persons per well	112	38, p. 3
3 to 4 miles	United Water PA Columbia Co. Industrial Park (1 well) x 28 persons per well	28	38, p. 3
3 to 4 miles	Stony Brook Circle MHP (2 wells) x 200 persons per well	400	38, p. 3

Notes:

Co. - County

MHP - Mobile Home Park

PA - Pennsylvania

PPL - Pennsylvania Power and Light

## Distance-weighted Population Values

<b>Distance Category (miles)</b>	<b>Population</b>	<b>Distance-Weighted Population Value</b>	<b>References</b>
0 - 0.25	0	0	1, Table 3-12; 3; 41
0.25 - 0.50	0	0	1, Table 3-12; 3; 38
0.50 - 1	0	0	1, Table 3-12; 3; 38
1 - 2	1,687	294	1, Table 3-12; 3; 38
2 - 3	1,162	212	1, Table 3-12; 3; 38
3 - 4	428	42	1, Table 3-12; 3; 38

Sum of Distance-Weighted Population Values: 548  
X 0.1 (as applied to Reference 1 Section 3.3.2.4) = 54.8

Potential Contamination Factor Value: 54.8  
Reference: 1, Section 3.3.2.4

### **3.3.3 Resources**

Wells used for resources were not identified within the 4-mile radius.

Resources Factor Value: 0  
Ref.: 1, Section 3.3.3

### **3.3.4 Wellhead Protection Area**

No documentation indicates that wellhead protection areas are located within a 4-mile radius of the SLC facility.

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Wellhead Protection Area Value: 0  
Ref.: 1, Section 3.3.4

#### **4.1 OVERLAND/FLOOD MIGRATION COMPONENT**

##### **4.1.1.1 DEFINITION OF HAZARDOUS SUBSTANCE MIGRATION PATH FOR OVERLAND/FLOOD COMPONENT**

The storm drains on the SLC property direct surface water runoff directly into the North Branch of the Susquehanna River, which is located immediately adjacent to the southern boundary of the property (Refs. 10, p. 3; 58). From this point of entry, the North Branch of the Susquehanna River flows west-southwest for more than 15 miles, completing the 15-mile surface water target distance limit (TDL) (Ref. 58). The average flow rate for the North Branch of the Susquehanna River downstream of SLC at Danville, Pennsylvania, is between 10,000 and 100,000 cubic feet per second (cfs) (Ref. 43, p. 2). The southern portion where all onsite sources are located, of the SLC facility property, from the bank of the North Branch of the Susquehanna River to about 200 feet inland from the river's bank, is within the 100 year flood plain of the river (Ref. 25).

An old canal ran adjacent to the North Branch of the Susquehanna River from Sunbury to Scranton, Pennsylvania, and was about 100 feet wide and 15 feet deep (Ref. 6, p. 78). This canal was subdivided into as many as five lagoons on the SLC property (Ref. 6, p. 78).

#### 4.1.2.1 LIKELIHOOD OF RELEASE

##### 4.1.2.1.1 Observed Release

###### Direct Observation

From June 23 to 26, 1972, the SLC facility was flooded as a result of Tropical Storm Agnes. During the storm, the interior of the evaporator house, which housed the liquid waste tanks, was submerged under about 10 feet of water. Tank A contained about 500 gallons of tritiated wastewater prior to the flood. A sample collected from the flood water inside of the building contained 0.0007  $\mu\text{Ci/ml}$  of tritium (Ref. 24). The tritium in the flood water inside the building reportedly is the result of the discharge of the tritiated wastewater from Tank A and subsequent discharge into the Susquehanna River. In addition, during Tropical Storm Agnes (also called Hurricane Agnes), both the east and west lagoons were flooded (Refs. 4, p. 3.7, Appendix 2, p. 8; 44, p. 6).

In July 1982, the NRC collected surface water samples from the east lagoon and the drainage ditch adjacent to the lagoon area (Ref. 10, p. 8, Figure 12). Additionally, 10 sediment samples were collected from the North Branch of the Susquehanna River, and the SLC liquid effluent outfall (Ref. 10, p. 9, Figures 15, 16). Quality assurance information is not available for this study; therefore, these samples are included for documentation purposes only. The surface water sample (W2-Drainage Ditch) collected from the ditch adjacent to the lagoon area contained concentrations of radium-226 ( $3.3 \pm 1.8 \times 10^{-10} \mu\text{Ci/ml}$ ), strontium-90 ( $6.4 \pm 2.0 \times 10^{-9} \mu\text{Ci/ml}$ ), and tritium ( $6.1 \pm 3.7 \times 10^{-7} \mu\text{Ci/ml}$ ) (Ref. 10, Table 4). A surface water sample (W11) collected from the SLC facility outfall contained cesium-137 at a concentration of  $13 \pm 11 \times 10^{-9} \mu\text{Ci/ml}$  (Ref. 10, Table 10). A sediment sample (R4) collected near the SLC outfall in the North Branch of the Susquehanna River contained radionuclides at the following concentrations: radium-226 ( $0.45 \pm 0.05$  picocuries per gram [ $\text{pCi/g}$ ]), cesium-137 ( $0.40 \pm 0.04 \text{ pCi/g}$ ), strontium-90 ( $1.69 \pm 0.40 \text{ pCi/g}$ ), and tritium ( $0.45 \pm 0.50 \text{ pCi/g}$ ) (Ref. 10, Table 11).

###### Chemical Analysis

Observed release by chemical analysis was not evaluated since an observed release by direct observation has been established.

Attribution:

During World War II, the SLC facility was a wooden toy factory (Ref. 7, p. 1; 8, p. 1). After World War II, the facility was sold as surplus property to the USRC, which converted the factory and property into a radium and radioisotope processing facility (Ref. 7, p. 1; 8, p. 1). Operations at the SLC facility have taken place at this location since the late 1940s (Ref. 9, Section 5).

Early activities at SLC involved production of glow-in-the-dark markers for hatch openings in naval vessels (Ref. 37, p. 1). These signs were made with strontium-90 mixed with zinc sulphide phosphor (Ref. 14, p. 2). During the 1950s and 1960s, operations at the USR facility included the use of Americium-241, cobalt-60, iron-55, carbon-14, radium-226, strontium-90, promethium-147, thallium-204, nickel-63, cesium-137, neptunium-237, polonium-210, uranium-238, and krypton-85 (Refs. 7, p. 2; 8, p. 1; 9, Section 5; 10, p. 2; 12, p. 1; 13, p. 2). Presently, SLC manufactures exit signs, dials, paints, gas chromatograph foils, and accelerator targets, which are illuminated with tritium (Refs. 6, pp. 3, 4; 10, p. 2; 37, p. 1). Low-level radioactive wastes such as tritium is disposed of by shallow burial on land (Ref. 51, p. 311).

Wastes from facility operations were buried on the property and included radium-226, cesium-137, and strontium-90 (Ref. 10, p. 2). Contaminated laboratory glassware was also buried on the property (Ref. 14, p. 3). Contaminated solids were placed inside of two silos buried in the ground, which were 12 feet deep by 10 feet wide (Ref. 12, p. 2). Concentrated liquid wastes were allowed to evaporate, and the dry residuals were transferred to the Radiological Services Company (Ref. 7, p. 3). Additionally, plant effluent was discharged into the abandoned canal, located adjacent to the North Branch of the Susquehanna River (Ref. 15, p. 7). The canal was a series of about five individual impoundments, which were all part of the former river bed (Ref. 15, pp. 1, 2, 4, 7). These impoundments were filled with river water, allowing the wastes in them to be diluted prior to discharge into the North Branch of the Susquehanna River (Ref. 15, pp. 2, 5).

Available file information indicates that radioactive wastes also were disposed of in a dry well. However, the location of the dry well is not known (Ref. 8, p. 1). Analyses of samples collected from the east lagoon indicated the presence of inorganic constituents and radionuclides including tritium, americium-241, strontium-90, cesium-137, and radium-226 (Refs. 10, p. 13; 28, p. 19; 36, pp. 7, 8). During the 1981 NRC investigation, surface and subsurface soil samples collected from the SLC facility contained radionuclides including radium-226, cesium-137, tritium, and strontium-90 (Ref. 10, pp. 14, 43, 44 through 47). The NRC investigation concluded that soil and water contamination are present in areas previously used for waste disposal activities and are evidence of radionuclide migration from the SLC facility (Ref. 10, p. 16).

In June 1972, Tropical Storm Agnes caused the North Branch of the Susquehanna River to flood the evaporator house at USRC (Ref. 24, p. 1). The evaporator house was used to evaporate liquid off of the sludges produced in facility processes. This building was completely submerged under about 10 feet of water during this flood (Ref. 24, p. 1). The water inside of the building contained tritium at a concentration of  $0.7 \times 10^{-3} \mu\text{Ci/ml}$  (Ref. 24, p. 1). It was estimated that about 500 gallons of the tritiated wastewater was released during the flood (Ref. 24, p. 1).

In 2002, PADEP collected a soil sample from a “hot spot” located south of the former location of the excavated silos (Ref. 57, pp. 2, 4, 8). Analyses of the soil sample contained the following radionuclides: radium -226 (25,013,482 pCi/Kg), strontium-90 (12,003 pCi/Kg), radium-228 (12,308 pCi/Kg), cesium-137 (653 pCi/Kg), and tritium (6,216 pCi/Kg) (Ref. 57, pp. 5, 9, A15).

Hazardous Substances Released:

Tritium

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Observed Release Factor Value: 550

#### **4.1.2.1.2 POTENTIAL TO RELEASE**

##### **4.1.2.1.2.1 Potential to Release by Overland Flow**

Potential to release was not evaluated, because an observed release to surface water was established by direct observation (see Section 4.1.2.1.1 of this HRS documentation record).

**4.1.2.2 WASTE CHARACTERISTICS****4.1.2.2.1 Toxicity/Persistence**

<b>Hazardous Substance</b>	<b>Source Number</b>	<b>Toxicity Factor Value (Table 2-4)</b>	<b>Persistence Factor Value<sup>a</sup> (Table 4-11)</b>	<b>Toxicity/Persistence Factor Value (Table 4-12)</b>	<b>Reference(s)</b>
Bismuth-214	1	b	b	b	
Cesium-137	1, 4	10,000	1	10,000	2, p. BI-13
Francium-223	1	b	b	b	
Lead-210	1	10,000	1	10,000	2, p. BI-13
Lead-214	1	b	b	b	
Potassium-40	1	b	b	b	
Protactinium-231	1	b	b	b	
Radium-223	1	b	b	b	
Radium-224	1	b	b	b	
Radium-226	1, 2, 4	10,000	1	10,000	2, p. BI-14
Strontium-90	4	10,000	1	10,000	2, p. BI-14
Thorium-231	1	1,000	0.4	400	2, p. BI-15
Thorium-234	1	10,000	1	10,000	2, p. BI-15
Tritium	1, 2, 3, 4, 5	100	1	100	2, p. BI-15
Uranium-235	1	10,000	1	10,000	2, p. BI-15
Antimony	1, 2	10,000	1	10,000	2, p. BI-1
Arsenic	1	10,000	1	10,000	2, p. BI-1
Cadmium	1, 2, 3, 4	10,000	1	10,000	2, p. BI-2
Chromium	1, 2, 3, 4	10,000	1	10,000	2, p. BI-3
Copper	1, 2, 3, 4	<sup>c</sup>	1	<sup>c</sup>	2, p. BI-3
Cyanide	2, 4	100	1	100	2, p. BI-4
Lead	1, 2, 3	10,000	1	10,000	2, p. BI-8
Nickel	2, 4	10,000	1	10,000	2, p. BI-9
Selenium	1, 2, 4	100	1	100	2, p. BI-10

<b>Hazardous Substance</b>	<b>Source Number</b>	<b>Toxicity Factor Value (Table 2-4)</b>	<b>Persistence Factor Value<sup>a</sup> (Table 4-11)</b>	<b>Toxicity/Persistence Factor Value (Table 4-12)</b>	<b>Reference(s)</b>
Silver	1, 2, 3, 4	100	1	100	2, p. BI-10
Mercury	1, 2, 3, 4	10,000	1	10,000	2, p. BI-8
Zinc	1, 2, 4	10	1	10	2, p. BI-12
Chlorobenzene	1	100	0.0007	0.07	2, p. BI-3

Notes:

<sup>a</sup> = Persistence factor value for rivers

<sup>b</sup> = Substance not in the Superfund Chemical Data Matrix (SCDM)

<sup>c</sup> = No toxicity value in the SCDM

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Toxicity/Persistence Factor Value: 10,000

Ref. 1, Section 4.1.2.2.1

**4.1.2.2.2 Hazardous Waste Quantity**

<b>Source Number</b>	<b>Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)</b>	<b>Is source hazardous constituent quantity data complete? (Yes/No)</b>
1	37,273.91	No
2	248.45	No
3	57.69	No
4	>0	No
5	19.20	No
<b>Sum of Values: 37,599.25</b>		

The HWQ is based on an estimated activity content of 186.23 curies of radionuclides in the silos, Source No. 1 (Refs. 1, Section 7.2.5.1.1; 26). The curies of radionuclides was converted to the equivalent lbs of non-radioactive hazardous substances by multiplying by 1,000;  $186.23 \text{ curies} \times 1,000 = 186,230 \text{ lb}$  (Refs. 1, Section 7.2.5.1.1, Table 2-5; 26). The average or mean constituent waste quantity using 5 samples collected from the silos was calculated as follows:  $186,230 \text{ lb} \div 5 = 37,246 \text{ lb}$  (Ref. 26). The constituent quantity for Source No. 1 was added to the source hazardous waste quantities for Source Nos. 2 through 5 resulting in a sum of values of 37,978.58. This information applied to Table 2-6 of Reference 1, yields an HWQ value of 10,000 for the site.

**4.1.2.2.3 Waste Characteristics Factor Category Value**

Toxicity/persistence factor value (10,000)  
 x hazardous waste quantity factor value (10,000):  $1 \times 10^8$

Reference 1, Section 2.4.2.2, 2.4.3.1, 7.2.5.3

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Hazardous Waste Quantity Factor Value: 10,000  
 Waste Characteristics Factor Category Value: 100

#### **4.1.2.3 DRINKING WATER TARGETS**

No drinking water intakes have been identified within the 15-mile surface water TDL (Ref. 39, p. 2).

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Nearest Intake Factor Value: 0

**4.1.2.3.3 Resources**

The North Branch of the Susquehanna River is used for boating, fishing, and waterfowl hunting. There are surface water intakes used for agricultural purposes downstream of Bloomsburg, Pennsylvania within the 15-mile target distance limit (Ref. 45, pp. 2, 3).

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Resources Factor Value: 5

**4.2.3.2 WASTE CHARACTERISTICS****4.1.3.2.1 Toxicity/Persistence/Bioaccumulation**

<b>Hazardous Substance</b>	<b>Source Number</b>	<b>Toxicity Factor Value</b>	<b>Persistence Factor Value<sup>a</sup> (Table 4-11)</b>	<b>Bioaccumulation Factor Value<sup>b</sup> (Table 4-15)</b>	<b>Toxicity/Persistence/Bioaccumulation Factor Value (Table 4-16)</b>	<b>References</b>
Bismuth-214	1	c	c	c	c	
Cesium-137	1, 4	10,000	1	5	50,000	2, p. BI-13
Francium-223	1	c	c	c	c	
Lead-210	1	10,000	1	5	50,000	2, p. BI-13
Lead-214	1	c	c	c	c	
Potassium-40	1	c	c	c	c	
Protactinium-231	1	c	c	c	c	
Radium-223	1	c	c	c	c	
Radium-224	1	c	c	c	c	
Radium-226	1, 2, 4	10,000	1	0.5	5,000	2, p. BI-14
Strontium-90	4	10,000	1	5	50,000	2, p. BI-14
Thorium-231	1	1,000	0.4	0.5	200	2, p. BI-15
Thorium-234	1	10,000	1	0.5	5000	2, p. BI-15
Tritium	1, 2, 3, 4, 5	100	1	0.5	50	2, p. BI-15
Uranium-235	1	10,000	1	0.5	5,000	2, p. BI-15
Antimony	1, 2	10,000	1	5	50,000	2, p. BI-1
Arsenic	1	10,000	1	5	50,000	2, p. BI-1
Cadmium	1, 2, 3, 4	10,000	1	5,000	$5.0 \times 10^7$	2, p. BI-2
Chromium	1, 2, 3, 4	10,000	1	500	$5.0 \times 10^6$	2, p. BI-3
Copper	1, 2, 3, 4	<sup>d</sup>	1	500	<sup>d</sup>	2, p. BI-3
Cyanide	2, 4	100	1	0.5	50	2, p. BI-4
Lead	1, 2, 3	10,000	1	5	50,000	2, p. BI-8

SWOF/Food Chain-Toxicity/Persistence/Bioaccumulation

<b>Hazardous Substance</b>	<b>Source Number</b>	<b>Toxicity Factor Value</b>	<b>Persistence Factor Value<sup>a</sup> (Table 4-11)</b>	<b>Bioaccumulation Factor Value<sup>b</sup> (Table 4-15)</b>	<b>Toxicity/Persistence/Bioaccumulation Factor Value (Table 4-16)</b>	<b>References</b>
Nickel	2, 4	10,000	1	0.5	5,000	2, p. BI-9
Selenium	1, 2, 4	100	1	50	5,000	2, p. BI-10
Silver	1, 2, 3, 4	100	1	50	5,000	2, p. BI-10
Mercury	1, 2, 3, 4	10,000	1	50,000	$5.0 \times 10^8$	2, p. BI-8
Zinc	1, 2, 4	10	1	5	50	2, p. BI-12
Chlorobenzene	1	100	0.0007	50	3.5	2, p. BI-3

Notes:

<sup>a</sup> = Persistence factor value for rivers

<sup>b</sup> = Freshwater value used for bioaccumulation

<sup>c</sup> = Substance not in the Superfund Chemical Data Matrix (SCDM)

<sup>d</sup> = No toxicity value in the SCDM

---

Toxicity/Persistence/Bioaccumulation Factor Value:  $5 \times 10^8$   
Ref. 1, Section 4.1.3.2.1

**4.1.3.2.2 Hazardous Waste Quantity**

<b>Source Number</b>	<b>Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)</b>	<b>Is source hazardous constituent quantity data complete? (Yes/No)</b>
1	37,273.91	No
2	248.45	No
3	57.69	No
4	>0	No
5	19.20	No
<b>Sum of Values: 37,599.25</b>		

The HWQ is based on an estimated activity content of 186.23 curies of radionuclides in the silos, Source No. 1 (Refs. 1, Section 7.2.5.1.1; 26). The curies of radionuclides was converted to the equivalent lbs of non-radioactive hazardous substances by multiplying by 1,000;  $186.23 \text{ curies} \times 1,000 = 186,230 \text{ lb}$  (Refs. 1, Section 7.2.5.1.1, Table 2-5; 26). The average or mean constituent waste quantity using 5 samples collected from the silos was calculated as follows:  $186,230 \text{ lb} \div 5 = 37,246 \text{ lb}$  (Ref. 26). The constituent quantity for Source No. 1 was added to the source hazardous waste quantities for Source Nos. 2 through 5 resulting in a sum of values of 37,978.58. This information applied to Table 2-6 of Reference 1, yields an HWQ value of 10,000 for the site.

**4.1.3.2.3 Waste Characteristics Factor Category Value**

Toxicity/persistence factor value (10,000)  
x hazardous waste quantity factor value (10,000):  $1 \times 10^8$

(Toxicity/persistence (10,000) x hazardous waste quantity [10,000]  
x bioaccumulation potential factor value [50,000]):  $1 \times 10^{12}$

Reference 1, Sections 2.4.2.2, 2.4.3.2, 7.2.5.3

---

Hazardous Waste Quantity Assigned Value: 10,000  
Waste Characteristics Factor Category Value: 1,000

#### **4.1.3.3 HUMAN FOOD CHAIN THREAT-TARGETS**

##### **Actual Human Food Chain Contamination**

Actual contamination of a fishery has not been documented in the North Branch of the Susquehanna River.

##### **Closed Fisheries**

No known fisheries within the 15-mile surface water migration pathway TDL have been closed because of contamination. A fish consumption advisory has been issued for the North Branch of the Susquehanna River in Columbia County (Ref. 46, p. 2). The advisory is for the consumption of no more than two meals per month of smallmouth bass (Ref. 46, p. 2). The advisory was put into place because of mercury contamination (Ref. 46, p. 1). A Pennsylvania fish consumption advisory for the North Branch of the Susquehanna River in Columbia County for 1998 included channel catfish, quillback carp, walleye, and smallmouth bass, and was attributed to PCB contamination (Ref. 47, p. 6). A complete ban has been placed on all suckers from PCB contamination (Ref. 47, p. 6).

##### **Benthic Tissue**

No benthic tissue samples have been collected.

**4.1.3.3.1 Food Chain Individual**

<b>Identity of Fishery</b>	<b>Type of Surface Water Body</b>	<b>Dilution Weight</b>	<b>Reference</b>
North Branch of the Susquehanna River	Large river	0.0001	1, Table 4-13; 43

A food chain individual value of 20 was assigned based on an observed release to a perennial surface water body with a fishery downstream (Refs. 23; 45). The average annual flow rate for the North Branch of the Susquehanna River ranges between 10,000 and 100,000 cfs (Ref. 45, p. 1).

---

Food Chain Individual Factor Value: 20

**4.1.3.3.2 Population**

4.1.3.3.2.1 Level I Concentrations

No Level I concentrations have been documented.

=====

Level I Concentrations Factor Value: 0

4.1.3.3.2.2 Level II Concentrations

No Level II concentrations have been documented.

=====

Level II Concentrations Factor Value: 0

SWOF/Food Potential Human Food Chain Contamination

4.1.3.3.2.3 Potential Human Food Chain Contamination

Identity of Fishery	Annual Production in Pounds	Type of Surface Water Body	Average Annual Flow Rate	Population Value ( $P_i$ )	Dilution Weight ( $D_i$ )	Population Value x Dilution Weight ( $P_i \times D_i$ )	Reference
Susquehanna River	>0	Large River	>10,000 to 100,000 cfs	0.03	0.0001	$3.0 \times 10^{-6}$	1, Tables 4-13, 4-18; 43
Sum of Human Food Chain Population Values x Dilution Weights ( $P_i \times D_i$ ) = $3.0 \times 10^{-6}$							
Population Values x Dilution Weights ( $P_i \times D_i$ ) $3.0 \times 10^{-6} \div 10 = 3.0 \times 10^{-7}$							

Note:

cfs = Cubic feet per second

The flow rate of the North Branch of the Susquehanna River at Danville, Pennsylvania, about 20 miles downstream of SLC ranges between 10,000 and 100,000 cfs (Refs. 43; 58). Information was not available on the annual production of fish from the North Branch of the Susquehanna River. However, because the North Branch of the Susquehanna River is a fishery, the annual production was assumed to be greater than zero.

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Potential Human Food Chain Contamination Factor Value:  $3.0 \times 10^{-7}$

## 4.1.4.2 WASTE CHARACTERISTICS

## 4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

Hazardous Substance	Source Number	Ecosystem Toxicity Factor Value <sup>a</sup> (Table 4-19)	Persistence Factor Value <sup>b</sup> (Table 4-11)	Ecosystem Toxicity/Persistence Factor Value (Table 4-20)	Reference(s)
Bismuth-214	1	c	c	c	
Cesium-137	1, 4	10,000	1	10,000	2, p. BI-13
Francium-223	1	c	c	c	
Lead-210	1	10,000	1	10,000	2, p. BI-13
Lead-214	1	c	c	c	
Potassium-40	1	c	c	c	
Protactinium-231	1	c	c	c	
Radium-223	1	c	c	c	
Radium-224	1	c	c	c	
Radium-226	1, 2, 4	10,000	1	10,000	2, p. BI-14
Strontium-90	4	10,000	1	10,000	2, p. BI-14
Thorium-231	1	1,000	0.4	400	2, p. BI-15
Thorium-234	1	10,000	1	10,000	2, p. BI-15
Tritium	1, 2, 3, 4, 5	100	1	100	2, p. BI-15
Uranium-235	1	10,000	1	10,000	2, p. BI-15
Antimony	1, 2	100	1	100	2, p. BI-1
Arsenic	1	10	1	10	2, p. BI-1
Cadmium	1, 2, 3, 4	10,000	1	10,000	2, p. BI-2
Chromium	1, 2, 3, 4	10,000	1	10,000	2, p. BI-3
Copper	1, 2, 3, 4	10,000	1	10,000	2, p. BI-3
Cyanide	2, 4	1,000	1	1,000	2, p. BI-4
Lead	1, 2, 3	1,000	1	1,000	2, p. BI-8
Nickel	2, 4	100	1	100	2, p. BI-9

<b>Hazardous Substance</b>	<b>Source Number</b>	<b>Ecosystem Toxicity Factor Value<sup>a</sup> (Table 4-19)</b>	<b>Persistence Factor Value<sup>b</sup> (Table 4-11)</b>	<b>Ecosystem Toxicity/ Persistence Factor Value (Table 4-20)</b>	<b>Reference(s)</b>
Selenium	1, 2, 4	1,000	1	1,000	2, p. BI-10
Silver	1, 2, 3, 4	10,000	1	10,000	2, p. BI-10
Mercury	1, 2, 3, 4	10,000	1	10,000	2, p. BI-8
Zinc	1, 2, 4	10	1	10	2, p. BI-12
Chlorobenzene	1	10,000	0.0007	7	2, p. BI-3

Notes:

<sup>a</sup> = Ecosystem toxicity factor value for fresh water

<sup>b</sup> = Persistence for rivers

<sup>c</sup> = Substance not in the Superfund Chemical Data Matrix

<b>Hazardous Substance</b>	<b>Ecosystem Toxicity/ Persistence Factor Value</b>	<b>Ecosystem Bioaccumulation Factor Value<sup>a</sup> (Section 4.1.3.2.1.2)</b>	<b>Ecosystem Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-21)</b>	<b>Reference(s)</b>
Bismuth-214	b	b	b	
Cesium-137	10,000	5	50,000	2, p. BI-13
Francium-223	b	b	b	
Lead-210	10,000	50,000	$5.0 \times 10^8$	2, p. BI-13
Lead-214	b	b	b	
Potassium-40	b	b	b	
Protactinium-231	b	b	b	
Radium-223	b	b	b	
Radium-224	b	b	b	
Radium-226	10,000	0.5	5,000	2, p. BI-14
Strontium-90	10,000	5	50,000	2, p. BI-14
Thorium-231	400	0.5	200	2, p. BI-15
Thorium-234	10,000	0.5	5,000	2, p. BI-15
Tritium	100	0.5	50	2, p. BI-15
Uranium-235	10,000	0.5	5,000	2, p. BI-15
Antimony	100	5	500	2, p. BI-1
Arsenic	10	5,000	50,000	2, p. BI-1
Cadmium	10,000	50,000	$5.0 \times 10^8$	2, p. BI-2
Chromium	10,000	500	$5.0 \times 10^6$	2, p. BI-3
Copper	10,000	5,000	$5.0 \times 10^7$	2, p. BI-3
Cyanide	1,000	0.5	500	2, p. BI-4
Lead	1,000	50,000	$5.0 \times 10^7$	2, p. BI-8
Nickel	100	500	50,000	2, p. BI-9
Selenium	1,000	500	500,000	2, p. BI-10
Silver	10,000	50	500,000	2, p. BI-10
Mercury	10,000	50,000	$5.0 \times 10^8$	2, p. BI-8

<b>Hazardous Substance</b>	<b>Ecosystem Toxicity/ Persistence Factor Value</b>	<b>Ecosystem Bioaccumulation Factor Value<sup>a</sup> (Section 4.1.3.2.1.2)</b>	<b>Ecosystem Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-21)</b>	<b>Reference(s)</b>
Zinc	10	50,000	$5.0 \times 10^8$	2, p. BI-12
Chlorobenzene	7	5,000	35,000	2, p. BI-3

Notes:

<sup>a</sup> = Bioaccumulation factor values for fresh water

<sup>b</sup> = Substance not in the Superfund Chemical Data Matrix

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Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value:  $5.0 \times 10^8$   
Ref. 1, Section 4.1.4.2.1

**4.1.4.2.2. Hazardous Waste Quantity**

Source Number	Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)	Is source hazardous constituent quantity data complete? (Yes/No)
1	37,273.91	No
2	248.45	No
3	57.69	No
4	>0	No
5	19.20	No
<b>Sum of Values: 37,599.25</b>		

The HWQ is based on an estimated activity content of 186.23 curies of radionuclides in the silos, Source No. 1 (Refs. 1, Section 7.2.5.1.1; 26). The curies of radionuclides was converted to the equivalent lbs of non-radioactive hazardous substances by multiplying by 1,000; 186.23 curies x 1,000 = 186,230 lb (Refs. 1, Section 7.2.5.1.1, Table 2-5; 26). The average or mean constituent waste quantity using 5 samples collected from the silos was calculated as follows: 186,230 lb ÷ 5 = 37,246 lb (Ref. 26). The constituent quantity for Source No. 1 was added to the source hazardous waste quantities for Source Nos. 2 through 5 resulting in a sum of values of 37,978.58. This information applied to Table 2-6 of Reference 1, yields an HWQ of 10,000 for the site.

**4.1.4.2.3. Waste Characteristics Factor Category Value**

Ecosystem toxicity/persistence factor value (10,000)  
x hazardous waste quantity factor value (10,000): 1 x 10<sup>8</sup>

(Ecosystem toxicity/persistence [10,000] x hazardous waste quantity [10,000] x bioaccumulation potential factor value [50,000]): 5 x 10<sup>12</sup>

Reference 1, Section 2.4.3.1, 7.2.2, 7.2.3

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Hazardous Waste Quantity Factor Value: 10,000  
Waste Characteristics Factor Category Value: 1,000

#### **4.1.4.3 ENVIRONMENTAL THREAT - TARGETS**

##### Level I Concentrations

No Level I concentrations have been documented.

##### Most Distant Level II Sample

No Level II concentrations have been documented.

**4.1.4.3.1 Sensitive Environments**

4.1.4.3.1.1. Level I Concentrations

Sensitive Environments

No Level I concentrations have been documented.

Wetlands

No Level I concentrations have been documented.

Level I Concentrations Factor Value: 0  
Reference 1, Section 4.1.4.3.1.1

4.1.4.3.1.2. Level II Concentrations

Sensitive Environments

No Level II concentrations have been documented.

Wetlands

No Level II concentrations have been documented.

Sum of Sensitive Environments Value + Wetland Value: 0

Level II Concentrations Factor Value: 0

4.1.4.3.1.3 Potential ContaminationSensitive Environments

No potential sensitive environments were scored.

Wetlands

Type of Surface Water Body	Wetlands Frontage	Wetlands Value Based on Wetlands Frontage	Reference
Large river (North Branch of the Susquehanna River)	~1.8 miles	50	1, Tables 4-13, 4-24; 58
Total Wetlands Value: 50			

Surface Water Body	Sum of Sensitive Environments Values ( $S_i$ )	Wetlands Value ( $W_i$ )	Dilution Weight ( $D_i$ )	$D_i(W_i + S_i)$
North Branch of the Susquehanna River	0	50	0.0001	0.005

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Potential Contamination Factor Value: 0.005